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PLES I GEOTHERMAL DEVELOPMENT PROJECT

FINAL
ENVIRONMENTAL IMPACT STATEMENT
AND
SUPPLEMENTAL ENVIRONMENTAL IMPACT REPORT

Prepared for:

U.S. Bureau of Land Management
Bishop Resource Area Office

U.S. Forest Service
Inyo National Forest

Great Basin Unified Air
Pollution Control District

June 1989

Prepared by: Environmental Science Associates, Inc.

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BUREAU OF LAND MANAGEMENT
INYO NATIONAL FOREST
GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

FINAL
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENTAL ENVIRONMENTAL IMPACT REPORT

for the proposed
PLES I Geothermal Development Project

FES 89-15

Ed Hastey — 6-9-89

Edward Hastey
California State Director
Bureau of Land Management

Date

Don Tatheard — 6-7-89

for Dennis Martin
Forest Supervisor
Inyo National Forest

Date

Ellen Hardebeck — 6/7/89

Ellen Hardebeck
Air Pollution Control Officer
Great Basin Unified Air Pollution Control District

Date

Dear Reader:

Enclosed is the Final Environmental Impact Statement (EIS) and Supplemental Environmental Impact Report (SEIR) prepared for the PLES I Geothermal Development Project, Mono County, California. The Bureau of Land Management's Bishop Resource Area of the Bakersfield District, the Inyo National Forest, and the Great Basin Unified Air Pollution Control District cooperated in the preparation of this document. This EIS/SEIR analyzes the proposed PLES I 10 MWe (net) geothermal power plant and its associated facilities, including production and injection wells, pipelines, and electricity transmission lines. An alternate location for the power plant, a smaller power plant alternative, and the no-action alternative are also considered.

Text which has been added since the Draft EIS/SEIR was published is double-underlined and marked by a revision bar in the right margin. Deleted text is not indicated.

This EIS was prepared pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969. It also must comply with all provisions of the Endangered Species Act and the National Historic Preservation Act.

The Record of Decision has been included for your information. BLM intends to implement the Record of Decision by approving the PLES I Geothermal Project Plan of Development, Injection and Utilization. The action may be appealed within 30 days from the date of the filing of the Final EIS/SEIR with the Environmental Protection Agency. Any appeal must be submitted to the Interior Board of Land Appeals, Office of the Secretary, in accordance with the regulations at 43 CFR 4.400. No action will be taken by BLM until the close of the appeal period on the Record of Decision.

For further information contact:

Area Manager
Bishop Resource Area
787 N. Main Street, Suite P
Bishop, California 93514
(619) 872-4881

FINAL ENVIRONMENTAL IMPACT STATEMENT

AND SUPPLEMENTAL ENVIRONMENTAL IMPACT REPORT

PLES I Geothermal Development

CA-017-P006-60

State Clearinghouse No. 86122913

Mono County, California

VOLUME I: EIS/SEIR

Federal Lead Agency: U.S. Bureau of Land Management Bishop Resource Area

State Lead Agency: Great Basin Unified Air Pollution Control District

Cooperating Agency: U.S. Forest Service Inyo National Forest

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June 1989

PLES I GEOTHERMAL DEVELOPMENT PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT
AND SUPPLEMENTAL ENVIRONMENTAL
IMPACT REPORT
June 1989

VOLUME I: EIS/SEIR

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	ES-1
1.0 INTRODUCTION	1-1
1.1 Background	1-1
1.2 Purpose and Need for Action	1-4
1.3 Project Location and Study Area	1-5
1.4 Major Issues	1-6
1.4.1 Issues Analyzed in the EIS	1-6
1.4.1.1 Thermal Springs	1-6
1.4.1.2 Surface Water Contamination	1-6
1.4.1.3 Hydrologic Monitoring	1-6
1.4.1.4 Visual Resources	1-9
1.4.1.5 Mule Deer	1-9
1.4.1.6 Cumulative Impacts	1-9
1.4.2 Issues Considered but Not Further Discussed	1-9
1.5 Relationship to Federal and Local Plans, Policies, and Programs	1-10
1.5.1 BLM	1-10
1.5.2 Inyo National Forest	1-10
1.5.3 Mono County	1-11
1.5.4 Town of Mammoth Lakes	1-12
1.6 Authorizing Actions	1-13
1.7 Environmental Monitoring	1-13
2.0 PROPOSED ACTION AND ALTERNATIVES	
2.1 Proposed Action	2-1
2.1.1 Measures Incorporated as a Result of Previous Project Approval	2-5
2.1.2 Production Wellfield and Gathering System	2-10
2.1.2.1 Production Well Drilling and Testing Description	2-10
2.1.2.2 Production Wellhead and Downhole Facilities	2-11
2.1.2.3 Gathering System	2-13
2.1.3 Power Plant	2-13
2.1.3.1 Radial Turbo-Expander Generator	2-15
2.1.3.2 Additional Power Plant Facilities	2-17
2.1.4 Injection Wellfield and Distribution Facilities	2-19
2.1.4.1 Injection Well Drilling and Testing Description	2-19
2.1.4.2 Injection Pumps and Gathering System	2-20
2.1.5 Emergency Response and Prevention	2-20
2.1.5.1 Spill Prevention and Containment	2-20

TABLE OF CONTENTS (cont.)

		Page
2.1.5.1.1	Well Drilling, Testing and Construction	2-21
2.1.5.1.2	Operations	2-21
2.1.5.1.3	Project-Wide Emergency Spill Containment	2-22
2.1.5.2	Well Blowout Control	2-23
2.1.5.3	Fire Prevention and Control	2-23
2.1.6	Landscape, Revegetation, and Camouflage	2-24
2.1.6.1	Stockpiling of Topsoil	2-24
2.1.6.2	Mulching	2-24
2.1.6.3	Seeding	2-24
2.1.6.4	Seedling Planting	2-25
2.1.6.5	Container-Grown Plantings	2-25
2.1.6.6	Tree Spade Transplanting	2-25
2.1.6.7	Irrigation	2-26
2.1.6.8	Painting	2-26
2.1.6.9	Trenching and Retaining Walls	2-27
2.1.7	Hydrologic Monitoring Plan	2-27
2.2	Alternative Location Action	2-30
2.2.1	Measures Incorporated as a Result of Previous Project Approval	2-30
2.2.2	Production Wellfield and Gathering System	2-30
2.2.2.1	Production Well Drilling and Testing Description	2-32
2.2.2.2	Production Wellhead and Downhole Facilities	2-32
2.2.2.3	Gathering System	2-32
2.2.3	Power Plant	2-32
2.2.3.1	Radial Turbo-Expander Generator	2-33
2.2.3.2	Additional Power Plant Facilities	2-34
2.2.4	Injection Wellfield and Distribution Facilities	2-34
2.2.4.1	Injection Well Drilling and Testing Description	2-34
2.2.4.2	Injection Pumps and Gathering System	2-34
2.2.5	Emergency Response and Prevention	2-34
2.2.6	Landscape, Revegetation, and Camouflage	2-35
2.2.7	Hydrologic Monitoring Plan	2-35
2.3	Smaller Power Plant Alternative	2-35
2.3.1	Measures Incorporated as a Result of Previous Project Approval	2-35
2.3.2	Production Wellfield and Gathering System	2-35
2.3.2.1	Production Well Drilling and Testing Description	2-36
2.3.2.2	Production Wellhead and Downhole Facilities	2-36
2.3.2.3	Gathering System	2-36
2.3.3	Power Plant	2-36
2.3.3.1	Radial Turbo-Expander Generator	2-37
2.3.3.2	Additional Power Plant Facilities	2-39
2.3.4	Injection Wellfield and Distribution Facilities	2-39
2.3.4.1	Injection Well Drilling and Testing Description	2-39
2.3.4.2	Injection Pumps and Gathering System	2-39
2.3.5	Emergency Response and Prevention	2-40
2.3.6	Landscape, Revegetation, and Camouflage	2-40
2.3.7	Hydrologic Monitoring Plan	2-40
2.4	No-Action Alternative	2-40
2.5	Summary of Impacts	2-40

TABLE OF CONTENTS (cont.)

		Page
3.0	AFFECTED ENVIRONMENT	3-1
3.1.	Physical Environment	3-1
3.1.1	Air Quality	3-1
3.1.1.1	Climatological and Meteorological Setting	3-1
3.1.1.2	Air Quality Setting	3-3
3.1.1.2.1	Hydrogen Sulfide	3-4
3.1.1.2.2	Hydrocarbons	3-4
3.1.1.3	Regulatory Framework	3-6
3.1.2	Geology, Soils, and Erosion	3-7
3.1.2.1	Regional Geologic Setting	3-7
3.1.2.2	Local Geologic Setting	3-8
3.1.2.3	Geothermal Production and Injection Reservoirs	3-9
3.1.2.4	Geologic Hazards	3-9
3.1.2.4.1	Seismicity	3-9
3.1.2.4.2	Volcanic Hazard	3-10
3.1.2.4.3	Surface Deformation and Subsidence	3-12
3.1.2.4.4	Shallow Geothermal Fluids	3-13
3.1.2.5	Soils and Erosion Potential	3-13
3.1.3	Noise	3-15
3.1.3.1	Regulatory Framework	3-15
3.1.3.2	Noise Sources and Levels	3-16
3.1.3.3	Noise-Sensitive Land Uses	3-17
3.1.4	Hydrology	3-18
3.1.4.1	Conceptual Models of the Geothermal Reservoir	3-18
3.1.4.2	Surface Resources	3-19
3.1.4.2.1	Creeks	3-19
3.1.4.2.2	Thermal Springs	3-22
3.1.4.3	Subsurface Resources	3-27
3.1.4.4	Summary of Hydrologic Data from Wells	3-29
3.1.4.4.1	Pressure Data	3-29
3.1.4.4.2	Temperature Data	3-29
3.1.4.4.3	Chemical Data	3-30
3.1.4.5	Shallow Ground Water Use	3-32
3.2	Biological Environment	3-32
3.2.1	Vegetation	3-32
3.2.1.1	Plant Communities	3-33
3.2.1.2	Rare Plants	3-36
3.2.1.3	Botanically Sensitive Areas	3-36
3.2.2	Terrestrial Wildlife	3-37
3.2.3	Aquatic Resources	3-41
3.2.3.1	Aquatic Habitats and Species of Concern	3-41
3.2.3.2	Hot Creek Hatchery	3-44
3.3	Social Environment	3-46
3.3.1	Cultural Resources	3-46
3.3.1.1	Cultural Setting	3-46
3.3.1.2	Native American Values	3-46
3.3.1.3	Site-Specific Cultural Resources	3-47
3.3.2	Range Resources	3-50
3.3.3	Recreational Resources	3-50
3.3.4	Timber Resources	3-51

TABLE OF CONTENTS (cont.)

		Page
3.3.5	Transportation and Site Access	3-51
3.3.6	Visual Resources	3-52
3.3.6.1	Existing Programs, Plans and Policies for Managing Visual Resources	3-52
3.3.6.2	Sensitive Receptors	3-53
3.3.6.3	Regional Setting	3-54
3.3.6.4	Proposed Project Site	3-54
3.3.6.5	Alternative Power Plant Site	3-56
3.3.7	Socioeconomics	3-57
3.3.7.1	General Setting	3-57
3.3.7.2	Current Land Use	3-57
3.3.7.3	Economics	3-58
3.3.7.4	County Fiscal Considerations	3-59
3.3.7.5	Community Services	3-60
3.3.7.5.1	Schools	3-60
3.3.7.5.2	Police	3-63
3.3.7.5.3	Medical Facilities	3-64
3.3.7.5.4	Fire Protection	3-64
3.3.7.5.5	Street and Road Maintenance	3-65
3.3.7.5.6	Wastewater	3-65
3.3.7.5.7	Solid Waste	3-65
3.3.7.5.8	Utilities	3-66
3.3.8	Hazardous Materials	3-66
3.3.9	Geothermal Resource Lease	3-66
4.0	ENVIRONMENTAL CONSEQUENCES	4-1
4.1	Physical Environment	4-1
4.1.1	Air Quality	4-1
4.1.1.1	Particulate Emissions	4-1
4.1.1.1.1	Proposed Project Impacts	4-1
4.1.1.1.2	Alternative Location Impacts	4-2
4.1.1.1.3	Smaller Power Plant Alternative Impacts	4-3
4.1.1.1.4	No-Action Alternative Impacts	4-3
4.1.1.1.5	Abandonment and Reclamation Impacts	4-3
4.1.1.1.6	Cumulative Impacts	4-3
4.1.1.2	Heavy Equipment Emissions	4-4
4.1.1.2.1	Proposed Project Impacts	4-4
4.1.1.2.2	Alternative Location Impacts	4-5
4.1.1.2.3	Smaller Power Plant Alternative Impacts	4-5
4.1.1.2.4	No-Action Alternative Impacts	4-5
4.1.1.2.5	Abandonment and Reclamation Impacts	4-5
4.1.1.2.6	Cumulative Impacts	4-5
4.1.1.3	Hydrogen Sulfide Emissions	4-6
4.1.1.3.1	Proposed Project Impacts	4-6
4.1.1.3.2	Alternative Location Impacts	4-7
4.1.1.3.3	Smaller Power Plant Alternative Impacts	4-8
4.1.1.3.4	No-Action Alternative Impacts	4-8
4.1.1.3.5	Abandonment and Reclamation Impacts	4-8
4.1.1.3.6	Cumulative Impacts	4-8

TABLE OF CONTENTS (cont.)

			Page
	4.1.1.4	Hydrocarbon Emisions	4-9
		4.1.1.4.1 Proposed Project Impacts	4-9
		4.1.1.4.2 Alternative Location Impacts	4-10
		4.1.1.4.3 Smaller Power Plant Alternative Impacts	4-11
		4.1.1.4.4 No-Action Alternative Impacts	4-11
		4.1.1.4.5 Abandonment and Reclamation Impacts	4-11
		4.1.1.4.6 Cumulative Impacts	4-11
4.1.2	Geology, Soils and Erosion		4-12
	4.1.2.1	Geologic Hazards	4-12
		4.1.2.1.1 Proposed Project Impacts	4-12
		4.1.2.1.2 Alternative Location Impacts	4-14
		4.1.2.1.3 Smaller Power Plant Alternative Impacts	4-15
		4.1.2.1.4 No-Action Alternative Impacts	4-16
		4.1.2.1.5 Abandonment and Reclamation Impacts	4-16
		4.1.2.1.6 Cumulative Impacts	4-16
	4.1.2.2	Soil and Erosion	4-16
		4.1.2.2.1 Proposed Project Impacts	4-16
		4.1.2.2.2 Alternative Location Impacts	4-18
		4.1.2.2.3 Smaller Power Plant Alternative Impacts	4-19
		4.1.2.2.4 No-Action Alternative Impacts	4-19
		4.1.2.2.5 Abandonment and Reclamation Impacts	4-19
		4.1.2.2.6 Cumulative Impacts	4-19
4.1.3	Noise		4-20
	4.1.3.1	Construction Noise	4-20
		4.1.3.1.1 Proposed Project Impacts	4-20
		4.1.3.1.2 Alternative Location Impacts	4-22
		4.1.3.1.3 Smaller Power Plant Alternative Impacts	4-22
		4.1.3.1.4 No-Action Alternative Impacts	4-22
		4.1.3.1.5 Abandonment and Reclamation Impacts	4-22
		4.1.3.1.6 Cumulative Impacts	4-23
	4.1.3.2	Operational Noise	4-23
		4.1.3.2.1 Proposed Project Impacts	4-23
		4.1.3.2.2 Alternative Location Impacts	4-23
		4.1.3.2.3 Smaller Power Plant Alternative Impacts	4-24
		4.1.3.2.4 No-Action Alternative Impacts	4-24
		4.1.3.2.5 Abandonment and Reclamation Impacts	4-24
		4.1.3.2.6 Cumulative Impacts	4-24
4.1.4	Water Quality and Hydrology		4-25
	4.1.4.1	Surface Water Quality	4-25
		4.1.4.1.1 Proposed Project Impacts	4-25
		4.1.4.1.2 Alternative Location Impacts	4-29
		4.1.4.1.3 Smaller Power Plant Alternative Impacts	4-30
		4.1.4.1.4 No-Action Alternative Impacts	4-30
		4.1.4.1.5 Abandonment and Reclamation Impacts	4-32

TABLE OF CONTENTS (cont.)

			Page
		4.1.4.1.6 Cumulative Impacts	4-32
	4.1.4.2	Shallow Fresh Groundwater	4-33
		4.1.4.2.1 Proposed Project Impacts	4-33
		4.1.4.2.2 Alternative Location Impacts	4-34
		4.1.4.2.3 Smaller Power Plant Alternative Impacts	4-34
		4.1.4.2.4 No-Action Alternative Impacts	4-34
		4.1.4.2.5 Abandonment and Reclamation Impacts	4-34
		4.1.4.2.6 Cumulative Impacts	4-34
	4.1.4.3	Hydrothermal Resources	4-35
		4.1.4.3.1 Proposed Project Impacts	4-38
		4.1.4.3.2 Alternative Location Impacts	4-61
		4.1.4.3.3 Smaller Power Plant Alternative Impacts	4-62
		4.1.4.3.4 No-Action Alternative Impacts	4-63
		4.1.4.3.5 Abandonment and Reclamation Impacts	4-64
		4.1.4.3.6 Cumulative Impacts	4-64
4.2	Biological Environment		4-67
	4.2.1	Vegetation	4-67
		4.2.1.1 Proposed Project Impacts	4-67
		4.2.1.2 Alternative Location Impacts	4-67
		4.2.1.3 Smaller Power Plant Alternative Impacts	4-68
		4.2.1.4 No-Action Alternative Impacts	4-68
		4.2.1.5 Abandonment and Reclamation Impacts	4-68
		4.2.1.6 Cumulative Impacts	4-68
	4.2.2	Terrestrial Wildlife	4-69
		4.2.2.1 Proposed Project Impacts	4-69
		4.2.2.2 Alternative Location Impacts	4-71
		4.2.2.3 Smaller Power Plant Alternative Impacts	4-72
		4.2.2.4 No-Action Alternative Impacts	4-73
		4.2.2.5 Abandonment and Reclamation Impacts	4-73
		4.2.2.6 Cumulative Impacts	4-73
	4.2.3	Aquatic Resources	4-74
		4.2.3.1 Proposed Project Impacts	4-74
		4.2.3.2 Alternative Location Impacts	4-76
		4.2.3.3 Smaller Power Plant Alternative Impacts	4-77
		4.2.3.4 No-Action Alternative Impacts	4-77
		4.2.3.5 Abandonment and Reclamation Impacts	4-77
		4.2.3.6 Cumulative Impacts	4-78
4.3	Social Environment		4-78
	4.3.1	Cultural Resources	4-78
		4.3.1.1 Proposed Project Impacts	4-78
		4.3.1.2 Alternative Location Impacts	4-81
		4.3.1.3 Smaller Power Plant Alternative Impacts	4-84
		4.3.1.4 No-Action Alternative Impacts	4-84
		4.3.1.5 Abandonment and Reclamation Impacts	4-84
		4.3.1.6 Cumulative Impacts	4-84

TABLE OF CONTENTS (cont.)

		Page
4.3.2	Range Resources	4-86
	4.3.2.1 Proposed Project Impacts	4-86
	4.3.2.2 Alternative Location Impacts	4-86
	4.3.2.3 Smaller Power Plant Alternative Impacts	4-86
	4.3.2.4 No-Action Alternative Impacts	4-87
	4.3.2.5 Abandonment and Reclamation Impacts	4-87
	4.3.2.6 Cumulative Impacts	4-87
4.3.3	Recreational Resources	4-87
	4.3.3.1 Proposed Project Impacts	4-87
	4.3.3.2 Alternative Location Impacts	4-88
	4.3.3.3 Smaller Power Plant Alternative Impacts	4-89
	4.3.3.4 No-Action Alternative Impacts	4-89
	4.3.3.5 Abandonment and Reclamation Impacts	4-89
	4.3.3.6 Cumulative Impacts	4-89
4.3.4	Timber Resources	4-90
	4.3.4.1 Proposed Project Impacts	4-90
	4.3.4.2 Alternative Location Impacts	4-91
	4.3.4.3 Smaller Power Plant Alternative Impacts	4-91
	4.3.4.4 No-Action Alternative Impacts	4-91
	4.3.4.5 Abandonment and Reclamation Impacts	4-91
	4.3.4.6 Cumulative Impacts	4-92
4.3.5	Transportation and Site Access	4-92
	4.3.5.1 Proposed Project Impacts	4-92
	4.3.5.2 Alternative Location Impacts	4-92
	4.3.5.3 Smaller Power Plant Alternative Impacts	4-93
	4.3.5.4 No-Action Alternative Impacts	4-93
	4.3.5.5 Abandonment and Reclamation Impacts	4-93
	4.3.5.6 Cumulative Impacts	4-93
4.3.6	Visual Resources	4-94
	4.3.6.1 Proposed Project Impacts	4-94
	4.3.6.2 Alternative Location Impacts	4-96
	4.3.6.3 Smaller Power Plant Alternative Impacts	4-96
	4.3.6.4 No-Action Alternative Impacts	4-96
	4.3.6.5 Abandonment and Reclamation Impacts	4-96
	4.3.6.6 Cumulative Impacts	4-96
4.3.7	Land Use and Planning	4-99
	4.3.7.1 Proposed Project Impacts	4-99
	4.3.7.2 Alternative Location Impacts	4-99
	4.3.7.3 Smaller Power Plant Alternative Impacts	4-99
	4.3.7.4 No-Action Alternative Impacts	4-99
	4.3.7.5 Abandonment and Reclamation Impacts	4-100
	4.3.7.6 Cumulative Impacts	4-100
4.3.8	Employment, Population and Housing	4-100
	4.3.8.1 Proposed Project Impacts	4-100
	4.3.8.2 Alternative Location Impacts	4-103
	4.3.8.3 Smaller Power Plant Alternative Impacts	4-103
	4.3.8.4 No-Action Alternative Impacts	4-103
	4.3.8.5 Abandonment and Reclamation Impacts	4-103
	4.3.8.6 Cumulative Impacts	4-103

TABLE OF CONTENTS (cont.)

		Page
4.3.9	Economics	
4.3.9.1	Proposed Project Impacts	4-104
4.3.9.2	Alternative Location Impacts	4-106
4.3.9.3	Smaller Power Plant Alternative Impacts	4-106
4.3.9.4	No-Action Alternative Impacts	4-106
4.3.9.5	Abandonment and Reclamation Impacts	4-107
4.3.9.6	Cumulative Impacts	4-107
4.3.10	Community Services	4-107
4.3.10.1	Proposed Project Impacts	4-107
4.3.10.2	Alternative Location Impacts	4-112
4.3.10.3	Smaller Power Plant Alternative Impacts	4-112
4.3.10.4	No-Action Alternative Impacts	4-112
4.3.10.5	Abandonment and Reclamation Impacts	4-113
4.3.10.6	Cumulative Impacts	4-113
4.3.11	Hazardous Materials	4-115
4.3.11.1	Proposed Project Impacts	4-115
4.3.11.2	Alternative Location Impacts	4-117
4.3.11.3	Smaller Power Plant Alternative Impacts	4-117
4.3.11.4	No-Action Alternative Impacts	4-118
4.3.11.5	Abandonment and Reclamation Impacts	4-118
4.3.11.6	Cumulative Impacts	4-118
4.3.12	Geothermal Resource Lease	4-119
4.3.12.1	Proposed Project Impacts	4-119
4.3.12.2	Alternative Location Impacts	4-119
4.3.12.3	Smaller Power Plant Alternative Impacts	4-119
4.3.12.4	No-Action Alternative Impacts	4-120
4.3.12.5	Abandonment and Reclamation Impacts	4-120
4.3.12.6	Cumulative Impacts	4-120
4.4	Growth-Inducing Impacts	4-121
5.0	AGENCIES, ORGANIZATIONS, AND INDIVIDUALS CONSULTED	5-1
5.1	Public Agencies	5-1
5.1.1	Federal Agencies	5-1
5.1.2	State of California and Regional Agencies	5-2
5.1.3	County of Mono (and Special Local Districts)	5-3
5.1.4	Other Local Agencies	5-3
5.2	Private Organizations	5-3
5.3	Other Individuals	5-4
5.4	Chronology of Public Involvement	5-4

TABLE OF CONTENTS (cont.)

		Page
6.0	REPORT CONTRIBUTORS	6-1
7.0	REFERENCES CITED	7-1
8.0	GLOSSARY	8-1
9.0	INDEX	9-1
10.	FINAL EIS/SEIR MATERIALS	
10.1	Review Process	10-1
10.2	Comments	10-2
10.2.1	List of Persons Commenting	10-2
10.2.2	Written Comments and Hearing Summary	10-11
10.3	Response to Comments	10-170
10.3.1	General Comments	10-170
10.3.2	Alternatives	10-175
10.3.3	Physical Environment	10-178
	Air Quality	10-178
	Noise	10-179
	Geology, Soils, and Erosion	10-180
	Water Quality and Hydrology	10-182
10.3.4	Biological Environment	10-203
	Vegetation	10-203
	Terrestrial Wildlife	10-206
	Aquatic Resources	10-211
10.3.5	Social Environment	10-213
	Cultural Resources	10-213
	Recreational Resources	10-213
	Timber Resources	10-214
	Transportation	10-214
	Visual Resources	10-214
	Land Use and Planning	10-217
	Economics	10-218
	Community Services	10-219
	Geothermal Resources Lease	10-219
10.3.6	References Cited in Response to Comments	

TABLE OF CONTENTS (cont.)

LIST OF FIGURES

		Page
1-1	PLES Project Vicinity, Area, and Site Map	1-7
2-1	Proposed Project Site Layout	2-4
2-2	Typical Geothermal Drilling Site and Equipment Layout	2-12
2-3	Typical Production Well Completion Drawing	2-14
2-4	Power Plant Plot Plan	2-16
2-5	Power Plant Design	2-18
2-6	Alternate Site Facility Location	2-31
2-7	Smaller Size Alternate Plot Plan	2-38
3-1	Identified Faults and Alquist-Priolo Special Study Zones Within the Casa Diablo Area, Mono County, California	3-11
3-2	Surface Drainage Features of the Mammoth Creek Basin	3-20
3-3	Location of Faults, Thermal Features and Wells in the Southwest Long Valley Area	3-23
3-4	Geologic Cross-Section Along A-A'-A" Showing the Location of Selected Wells	3-28
3-5	Habitat Type Map	3-35
3-6	Deer Observations	3-42
3-7	U.S. Forest Service Visual Management Objectives for the Casa Diablo Hot Springs Area	3-55
4-1	Cross-Section along Line-of-Sight from Highway 395 Near Mammoth Creek to Proposed Power Plant Site	4-97
10-1	Location of Botanically Sensitive Areas in Relation to Proposed Project Facilities	10-203

VOLUME II: APPENDICES

Appendices are bound separately in Volume II

TABLE OF CONTENTS (cont.)

LIST OF TABLES

		Page
	Summary of Impacts	ES-18
1-1	Permits and Approvals	1-14
2-1	Summary Comparison of Alternatives	2-2
2-2	Seed Mix	2-25
2-3	Seedlings and Container-Grown Plants	2-26
2-4	Hydrologic Monitoring Plan	2-25
2-5	Summary of Impacts	2-41
3-1	Noncondensable Gases Contained Within Well SF 35-32	3-5
3-2	Physical Characteristics of Selected Hydrocarbon Fluids	3-6
3-3	Soil Interpretations	3-14
3-4	24-Hour Noise Levels Near Casa Diablo Hot Springs	3-17
3-5	Average Flowrate, Temperature, and Chemistry Data for Prominent Surface Hydrologic Features	3-21
3-6	Representative Geothermal Fluid Chemical and Physical Characteristics from Wells Located in or Adjacent to the PLES I Project Area	3-31
3-7	Taxable Sales - Mono County	3-60
3-8	Employment in Mono County	3-61
3-9	Distribution of Mammoth Lakes' Labor Force by Employment	3-62
3-10	General Revenues for Mono County	3-62
3-11	Approved Expenditures for Mono County	3-63
4-1	Typical Emissions From Diesel-Powered Heavy Equipment	4-4
4-2	Typical Construction Noise Levels at 50 Feet from Commercial/Industrial Construction Activities	4-21
4-3	Local Employment	4-101
4-4	Population Increases	4-102
4-5	Increased School Enrollment	4-108
10-1	Comment Index	10-4
10-2	Estimated Average Groundwater Use in Gallons per Month	10-190

EXECUTIVE SUMMARY

INTRODUCTION

Pacific Energy of Commerce, California has proposed the development of a geothermal wellfield and the construction and operation of a 10 MWe (net) geothermal power plant on federal land administered by the Inyo National Forest in Mono County, California. The U.S. Bureau of Land Management (BLM), as the applicable mineral resource management agency, and pursuant to federal regulation (43 CFR 3200), is lead agency with respect to compliance with the National Environmental Policy Act (NEPA) of 1969. The Great Basin Unified Air Pollution Control District is lead agency for compliance with the California Environmental Quality Act (CEQA).

The purpose of this document is to analyze the impacts of the four alternatives, including the proposed project, so that decision-makers will have adequate information on which to base their decision to approve the PLES I proposed project or one of the other alternatives. The decision will be made using the findings presented in this Environmental Impact Statement/Supplemental Environmental Impact Report (EIS/SEIR).

Background

The Plans of Operation for Development, Utilization and Injection, as amended, submitted by Pacific Energy were received by the BLM and describe the purpose of the project, which is to develop and utilize geothermal resources believed to exist within federal geothermal lease CA-11667. Toward this end, Pacific Energy proposes to drill and test geothermal wells, pump the subsurface geothermal fluids to the surface, extract heat from the produced fluids, convert that heat into electrical energy in a 10 MWe (net) binary-cycle power plant, and inject the cooled fluid to a subsurface injection reservoir.

Purpose and Need for Action

The need for the project was stated by the U.S. Congress in the Geothermal Steam Act of 1970, the Mining and Minerals Policy Act of 1970, the Federal Land Policy and Management Act of 1976, and the National Materials and Minerals Policy, Research, and Development Act of 1980.

These acts direct the Federal Government to foster and encourage private enterprise in the development of alternative energy resources within appropriate environmental constraints. Towards this end, each federal geothermal lessee is required to perform "... diligent exploration until there is a well(s) capable of commercial production on the leased lands." (43 CFR 3203.5). The lessee is also required to commercially produce or utilize the geothermal resource within ten years of the lease issuance or forfeit the geothermal lease. Federal policy encourages the use of alternate energy resources, such as the geothermal resource at Casa Diablo because unlike an electrical generation facility which utilizes oil, gas coal or other fossil fuels, the PLES I geothermal facility would utilize a clean, domestic energy resource, natural hot water, that would not produce stack emissions, such as carbon monoxide, nitrogen oxides, or particulates, which are produced by fossil fueled facilities. This energy resource would not, therefore, impact or produce emissions which would impact the Earth's ozone layer or add to the generation of photochemical smog. Also, the electricity produced by this facility would utilize an energy resource which is not dependent on foreign sources, unlike a significant percentage of the oil and gas utilized by this nation. The utilization of any alternate domestic energy resources would reduce this nation's energy dependence on foreign countries and strengthen our national security.

Project Location

The project is proposed for federal geothermal lease CA-11667, located in Geothermal Lease Block I within the Mono-Long Valley Known Geothermal Resource Area (KGRA). This 1,510-acre lease is located on land within the Inyo National Forest, three to four miles east of Town of Mammoth Lakes, Mono County, California. This area is in the southwestern part of the Long Valley Caldera, in the Mammoth Creek drainage basin.

Issues Analyzed in the EIS

During the earlier environmental review of the proposed project and in response to the Notice of Preparation for the EIS, attention was focused on a few major issues; thermal springs, particularly those at Hot Creek Hatchery and Hot Creek Gorge; the Hot Creek/Mammoth Creek fishery and other aquatic organisms in the area; hydrologic monitoring; visual resources; and mule deer. Cumulative impacts of the proposed PLES I project and other developments in the vicinity of the project area were also raised as a major issue.

Thermal Springs: Potential impacts to the thermal features are a major issue. Thermal water contributes to flows at several springs in the Casa Diablo/Hot Creek area including those at Hot Creek Gorge, a geological interpretive area, and those springs supplying Hot Creek Hatchery operated by Fish and Game. Hot Creek Gorge and Hot Creek Hatchery are important to the recreation-based economy of the region, in addition to their intrinsic value. Fish and Game has also raised the issue of snails and other aquatic invertebrates which may live in thermal springs and how they might be affected if the thermal contribution were changed. Issues regarding potential adverse impacts to thermal springs are discussed along with the related issues of the potential for geothermal reservoir pressure and temperature change.

Surface Water Contamination: Another major issue is the potential for spills or erosion from the project site which could cause damage to the Mammoth/Hot Creek fishery. Hot Creek is a nationally-known, catch-and-release, trophy trout stream and its protection is very important. This includes protection of the invertebrates and stream vegetation which provide food and shelter for the fish. The concern is that thermal and/or chemical degradation of the stream could result from accidental spills of geothermal fluids.

Hydrologic Monitoring: Issues were raised concerning specific monitoring methods; determination of critical reservoir parameters triggering remedial action; and the feasibility, potential effectiveness, and environmental consequences of proposed mitigation measures.

Visual Resources: Visual quality is highly valued in the region. People have expressed concern that the presence of an additional geothermal power plant would be visually intrusive and would have a detrimental effect on visitors and residents.

Mule Deer: Mule deer are abundant in Mono County and there is concern that development along the eastern side of the Sierra Nevada may jeopardize habitats and routes of migration crucial to the continued vitality of local deer herds.

Cumulative Impacts: Cumulative impacts are effects on the resources of an area or region caused by the combination of existing developments and uses along with proposed and reasonably foreseeable development. The major issues for the cumulative impacts analysis are the same as those described above for the project impacts analysis. The cumulative analysis in the EIS generally assesses impacts based on the development scenario described in Appendix F and discusses the relative contribution of the proposed project to the total cumulative impact.

Issues Considered but not Further Discussed

Extensive geothermal power generation occurs at the Geysers, a KGRA located largely in Sonoma and Lake Counties in northern California. During review of the Joint Draft EA/EIR, a number of commentors suggested that environmental impacts at the Geysers should be used to evaluate potential impacts on the project area. There are two major reasons the Geysers experience is not particularly relevant: topography and air cooling of the working fluid.

Siltation of salmonid spawning gravels and decreased food production in the form of benthic invertebrates are of particular concern at the Geysers. The steep slopes characteristic of the area are susceptible to erosion and landsliding and spills travel rapidly on the steep slopes. In addition, a great deal of earth moving, especially cut-and-fill is required by the topography of the Geysers in order to construct drill pads, access roads, and power plant sites. In contrast, the topography of Casa Diablo is gently sloping with very little cut-and-fill needed. Also significantly, the depth of the wells at the Geysers requires drill pads much larger than is needed for the shallow wells at Casa Diablo and the power plants at the Geysers are much larger than that proposed at Casa Diablo. The amount of surface disturbance at the Geysers is therefore many orders of magnitude larger than at Casa Diablo and is not realistically comparable. This impact would be much less severe at Casa Diablo because the topography is gently sloping and there are fewer perennial streams to be affected.

Spills at the Geysers have been primarily geothermal steam condensate from cooling towers and chemicals being transported to the plant sites. Condensate spills accounted for 82% of the spills from 1974 to 1984. About 2% of the spills were materials used for H_2S abatement and in the treatment of condensate (Warner et al., 1986). Therefore, over 80% of the spills are related to water cooling. At PLES I the geothermal fluid would be circulated in a closed system and the working fluid would be air cooled, so there would be no condensate nor would treatment of it be necessary.

Relationship to Federal and Local Plans, Policies, and Programs

The BLM is the agency responsible for management of geothermal resources on federal geothermal leases and enforcement of the provisions of the Geothermal Steam Act of 1970, 43 CFR 3200 regulations, and associated operational orders. The BLM is the designated federal lead agency under NEPA for preparation of this EIS.

BLM policies must be consistent with Forest Service, state, and local plans. The proposed project is consistent with federal law, regulation, planning, and policy.

Authorizing Actions

Discretionary approvals and permits from several agencies would be required for the project. These are summarized below. This EIS/SEIR has been prepared under NEPA Authorizing Actions Guidelines in response to BLM and Forest Service requirements and under CEQA regulations, with the Great Basin Unified APCD serving as Lead Agency for CEQA.

PERMITS AND APPROVALS

Agency	Permit/Approval	Facility
Great Basin Unified APCD	Authority to Construct	Power plant; all wells
	Permits to Operate	Power plant; all wells
California RWQCB Lahontan Region	Waste Discharge Orders	Power Plant; all wells
Bureau of Land Management	Plan of Exploration	Exploration wells, roads, drill pads
	Plan of Development	Production wells, roads, drill pads
	Plan of Injection	Injection wells, roads, drill pads
	Plan of Baseline Data Collection	Facilities necessary for the collection of baseline data
	Plan of Utilization	Power plant, pipelines, power lines
	Plan for Production	Production procedures and monitoring for royalty assessment

SOURCE: Thomas, T., 1987.

PROPOSED ACTION AND ALTERNATIVES

Proposed Project (the Preferred Alternative)

Pacific Energy proposes to construct and operate a 10 MWe (net) binary power plant and geothermal wellfield development project (PLES I Project) on federal geothermal lease CA-11667. The project area is located approximately three miles east of the Town of Mammoth Lakes, Mono County, California and is within the Long Valley East Geothermal Unit on land administered by the Inyo National Forest. The project area is within the Long Valley KGRA, immediately adjacent to the existing seven MWe (net) Mammoth-Pacific I geothermal resource electric generating facility (MP I)

The proposed project would include: the drilling, construction, and operation of geothermal production and injection wellfields; the construction and operation of the related production pipeline gathering and injection pipeline distribution systems; the construction and operation of a 10 MWe (net) binary power plant facility; and construction of control facilities. As part of the proposed project, all of the mitigating stipulations previously applied by the BLM have been adopted.

Geothermal fluid, produced from up to four geothermal production wells located in the vicinity of Casa Diablo Hot Springs, would be directed by surface pipelines to the proposed binary power plant facility. Approximately 5,000 gpm of geothermal fluid would be produced. After heat extraction, the cooled geothermal fluid would be directed from the power plant by surface pipeline up to four geothermal injection wells and injected into the subsurface injection reservoir. Approximately 13 acres would be disturbed in the development and operation of the proposed project.

Alternate Power Plant Location

Under the alternative location action, the project would use the same well fields, plant design, and power output. The well fields would remain in the same locations because the resource cannot be moved. The principal difference would be the relocation of the power plant to a location 0.6 miles north of the proposed site. The alternative location is about 150 feet higher in elevation than the proposed power plant site and approximately 3,000 feet from the production and injection fields. It may be necessary to pump up to 20% more geothermal fluid (up to a total

production capacity of the wells, it is possible that five production wells would be required. Two to four additional air coolers would be required, resulting in a power plant site 40 to 70 feet longer (about 0.5 acres larger) than the proposed power plant site. The power plant would have the same east-west orientation as the proposed power plant, but the sump would be located at the lowest elevation of the northwest corner. The gathering pipelines would be about 4,200 feet long and the distribution pipelines, about 4,500 feet long.

Smaller Power Plant Alternative

The smaller power plant alternative of about seven MWe (net) would be located at the site of the proposed project. It would use the same technology as the proposed project and would have two turbo expanders and generators, six heat exchangers, and 30 air condensers. The smaller power plant would be about 80 feet shorter in the westerly direction than the proposed project. Three production wells producing 3,800 gpm and three injection wells would be required.

Preferred Alternative and Comparison of Alternatives

The BLM in cooperation with the Forest Service has identified the proposed project as the preferred alternative. A summary comparison of the general characteristics of the proposed project and the alternatives is shown in the following table:

SUMMARY OF COMPARISON OF ALTERNATIVES/a/

	Proposed Project	Alternate Location	Smaller Alternative
Power Output (net) MWe	10	10	7
Power Plan Footprint (acres)	5.1	5.6	4.5
Generators (#)	3	3	2
Heat Exchangers (#)	9	9	6
Air Coolers (#)	40	42 to 44	30
Production Wells (#)	4	4 or 5	3
Production (gpm)	5,000	6,000	3,800
Length of Gathering Pipeline (feet)	2,600	4,200	2,400/c/
Length of Injection Pipeline (feet)	1,700	4,500	1,500/d/
Disturbed Area (acres)	13/b/	15	12

/a/ The no-action alternative would have none of the components listed above.
/b/ Taken from information provided to the BLM by Pacific Energy.
/c/ Assumes production well SF 35A-32 is not drilled.
/d/ Assumes injection well SFI 54A-32 is not drilled.

SOURCE: Pacific Energy and Environmental Science Associates, Inc.

AFFECTED ENVIRONMENT

PHYSICAL ENVIRONMENT

Air Quality

Air quality within the Mammoth Lakes/Long Valley area can be generally characterized as good during the summer months; however, during winter months federal and/or state air quality standards for nitrogen oxides, carbon monoxide, and particulate matter have occasionally been exceeded. The Great Basin Unified Air Pollution Control District is the local agency responsible for enforcing federal and state ambient air quality standards. The Great Basin Unified Air Pollution Control District monitored particulate matter smaller than 10 microns in diameter (PM_{10}) and hydrogen sulfide (H_2S) levels from January 1987 through December 1987 at a monitoring station approximately one mile east of the proposed project site. The purpose of the monitoring was to determine baseline concentrations upon which to evaluate the air quality effects of full-cycle geothermal resource development on the populated areas within Long Valley. The baseline concentrations of these pollutants were found to be well below the applicable ambient standards.

Geology

The project area is located along the southwestern edge of the resurgent dome of the Long Valley Caldera. The surface geology is dominated by post-caldera rhyolite lavas which form the resurgent dome and the moat basalt/andesite. A thin alluvium of 10- to 40-foot thickness covers these flows in most locations. Immediately below these basalt flows is a 1,200- to 1,500-foot thick rhyolitic lava interval. This post-caldera series of rhyolite flows with minor interbedded tuffs is the rock which forms the resurgent dome and constitutes the geothermal reservoir currently being exploited in the Casa Diablo area. Below the rhyolites is an 80- to 140-foot thick "landslide" horizon that is composed of granitic and metasedimentary lithic clasts which may represent a paleosol. The Bishop Tuff occurs beneath the "landslide" horizon. One deep well drilled in the Casa Diablo area, Union Mammoth #1, penetrated the full thickness (3,250 feet) of the Bishop Tuff and drilled into basement rock.

Geothermal Production

The Casa Diablo Geothermal production reservoir interval is approximately 300 to 600 feet below the surface within highly fractured rhyolite lavas. At Casa Diablo the proposed injection

zone is below 1,000 feet, within the uppermost portion of the Bishop Tuff.

Geologic Hazards

The proposed project area exists within a region of earthquake activity and active volcanism. A broad pattern of surface deformation in the caldera has been noted since the increase in earthquake activity along the length of the eastern escarpment of the Sierra Nevada range began in mid-1978.

Soils within the project site overlie basalt bedrock but were themselves formed from washed in material of granitic or rhyolitic source rocks. The texture is sand or loamy sand throughout, and soil thickness ranges from 40 inches to more than 60 inches. Geophysical studies of soil resistivity indicate that there may be very shallow hot water or steam at the proposed power plant site.

Noise

The major noise source at the project site is the existing MP I geothermal power plant located about 800 feet to the west of the proposed PLES I site. Operation of the MP I plant produces a continuous high level hum which has been measured at 63 to 66 dBA L_{eq} at 150 feet. Vehicular noise in the project area is minor. Intermittent aircraft noise is due to low-flying aircraft approaching and departing from Mammoth/June Lakes airport about four miles to the east of the project site.

Hydrology

The proposed project and alternative location sites are contained entirely within the Mammoth Basin, an area of approximately 60 square miles, which is defined by the surface watershed of Mammoth and Hot Creeks (including Sherwin and Laurel Creeks). These creeks flow across the Long Valley Caldera to the Owens River and then into Lake Crowley. Other small creeks in the vicinity include Dry Creek, Little Hot Creek, and Convict Creek. In addition to the creeks which drain the area, a number of springs contribute to surface flows.

Drilling and geophysical studies in the Long Valley Caldera have indicated the presence of thermal fluids at various depths and locations in the south and southwest areas, including the Casa Diablo area in general and the project site in particular. Subsurface hydrologic resources in the Casa Diablo area are characterized by shallow localized cold groundwater at zero to 40-foot

depth, underlain by a thermal protection zone at a depth of 300 to 600 feet where temperatures range from approximately 330° to 350°F. A second thermal zone is located at depths of 1,500 to 2,600 feet (with temperatures about 305°F).

Scientists working in the Long Valley area have proposed two different conceptual models to explain hydrological features in the area, both of which can be supported by observed data. One model, called the Lateral Flow Model, assumes a single hot water resource supplies all the thermal features in the area. In this model, the hot water migrates up faults until it encounters the reservoir rock through which the eastward flow can be maintained. This model implies that production of hot fluids from one zone and injection into another could result in pressure and/or temperature changes in nearby areas which are hydraulically connected to the same lateral zones.

The second model is called the Upwelling/Fracture Flow Model. Under the scenario proposed by this model, the nearly vertical faults which cut across the area serve as conduits to carry heated water up from deep reservoirs. It has been suggested that fluids move from south to north, roughly along the strike of the major faults. This would suggest poor hydraulic connection between reservoirs for each thermically active area and little potential for interface between the Casa Diablo area and Hot Creek Hatchery or Hot Creek Gorge.

BIOLOGICAL ENVIRONMENT

Vegetation

The climate, altitude, and vegetation of the proposed geothermal project area include two distinctive life zones common to the eastern Sierra Nevada region: Upper Sonoran Zone (at lower altitudes) and Transition zone (at upper altitudes). Each of the life zones contains distinctive plant communities which provide characteristic habitat for wildlife species.

Both mountain and desert plants characterize the flora located in the Casa Diablo Hot Springs area. More than 160 species of vascular plants were observed within the survey area during the surveys.

Two principal habitat types were found in the survey area: (1) forest/woodland vegetation with Jeffrey pine (Pinus jeffreyi) and pinyon pine (Pinus monophylla) dominating; and (2) shrub vegetation with sagebrush (Artemisia tridentata ssp. vaseyana) dominating. In addition, ten different habitat types were observed and mapped within the survey area.

Twelve plants, considered rare or endangered by the California Native Plant Society (CNPS), could potentially occur in the vicinity of the proposed project. However, no rare or endangered vascular plant species were observed during the plant surveys conducted in November 1987 and June 1988 in the proposed project area. Earlier thorough botanical investigations and botanical collecting trips at the Casa Diablo Hot Springs found no rare or endangered species there.

Two habitat types occurring in the survey area, thermal marsh and rhyolite buckwheat scrub, are considered botanically sensitive by Fish and Game.

Terrestrial Wildlife

The plant communities of the region provide habitats for a diversity of resident and migratory wildlife. Over 400 species of terrestrial vertebrates have been recorded in the Inyo National Forest. Some species are restricted to single habitats, while other species range over almost all the habitats in the region. Similarly, major streams and spring drainage areas in the region provide unique aquatic habitats for native and introduced species.

Pine forest and sagebrush shrub are the principal wildlife habitats found within the survey area. Some meadow vegetation and rock outcrops are also located in the survey area. Jeffrey and pinyon pine provide both food and nesting sites for mammals and birds.

There are eight migrant or resident species of concern that could potentially inhabit or use the Casa Diablo Hot Springs area. Of these, the mule deer is most susceptible to impact. Mule deer have been observed within the survey area and evidence of mule deer in the Casa Diablo Hot Springs area was observed. This deer movement does not appear to be concentrated in any localized portion of the survey area, but is dispersed throughout it.

Aquatic Resources

No perennial streams are found within the project area itself, but the western portion is crossed by a small intermittent stream which originates in ephemeral lakes west of the area. No riparian vegetation is connected with the stream, and no salmonid aquatic species are believed to exist within the stream. The intermittent stream drains into Mammoth Creek about 0.6 miles from the proposed power plant site. Mammoth Creek joins Hot Creek just below Hot Creek Hatchery, a hatchery operated by Fish and Game, which uses water from springs containing 2% to 3% thermal flow.

Aquatic invertebrates in Mammoth Creek are dominated by caddisflies, stoneflies, and mayflies. Hot Creek invertebrate fauna consists primarily of amphipods and caddisflies.

Both Mammoth and Hot Creeks support naturally spawning populations of rainbow and brown trout. Fish and Game Department stocks trout in Mammoth Creek upstream of Highway 395. Hot Creek is one of only two state-classified wild trout fisheries in the Inyo National Forest. The Hot Creek headwater springs also provide a unique habitat for the state and federally listed endangered Owens tui chub (Gila bicolor synderi).

SOCIAL ENVIRONMENT

Cultural Resources

Results from numerous archaeological investigations suggest the Owens-Long Valley region was once inhabited and used, for subsistence purposes, by numerous groups of hunter-gatherers over a period of 8,000 to 9,000 years. The latest peoples to inhabit the region were Numic-speaking groups.

Any site which Native Americans considered sacred is very sensitive to impacts. Springs and other sources of water, especially hot springs or springs where healing rites are performed, are especially sensitive, having sacred connotations. Thus, Casa Diablo Geyser and other hot springs and fumaroles in the project area could be considered important, although no sites near the proposed project have been identified as sacred by Native Americans.

Site-specific cultural resources surveys were conducted, in conformance with requirements of the United States Forest Service, on Federal lease CA-11667 which contains the proposed project area. Six sites were identified to contain cultural resources.

Range Resources

The proposed project area is located within the Long Canyon Unit of the Hot Creek Grazing Allotment. It provides about 6 AUMs per acre.

Recreational Resources

The project area is three miles east of the Town of Mammoth Lakes (population approximately 5,000) and nearby Mammoth Mountain Ski Area. Summertime recreation uses in Mammoth Lakes includes backpacking, camping, fishing, mountaineering, swimming, boating and

sightseeing. Hot Creek Hatchery, known for developing a unique strain of rainbow trout, is three miles east of the site at the headwaters of Hot Creek. Hot Creek Hatchery raises over 700,000 catchable size trout and 1.25 million fingerling trout for stocking in the Inyo-Mono area annually. Immediately east of the hatchery, Hot Creek Ranch offers trophy trout fishing from May 1st to October 30th. During the fishing season the ranch averages 15,000 to 20,000 visitor-days. The Hot Creek recreational area also contains the Hot Creek Gorge, where hot springs emerge in Hot Creek. It is a favorite recreational spot for visitors to the Mammoth area and is open to the public throughout the year. Dispersed recreational activities in the project vicinity include canoeing, shooting, wood collecting, jogging, bicycling, snowmobiling, and deer hunting.

Timber Resources

The project site (about 24,000 board-feet per acre, where forested) and the alternate power plant site (about 30,000 board-feet per acre) are not managed for commercial timber production but are located near the southern edge of an area within the Inyo National Forest which is managed for commercial timber production. The project site is not an important timber resource.

Transportation and Access

The proposed project area is located near the intersection of Hot Springs Road (Mono County Road No. 346A) and California State Route 203. It is immediately accessible from the Mammoth Lakes offramp (Route 203) from existing U.S. Highway 395 (Highway 395). Highway 395 is the major north-south highway along the eastern Sierras. The portion of Highway 395 near the project area is a four-lane divided highway with seasonally heavy traffic, particularly during the winter ski seasons. California State Route 203 is a two-lane paved road east of Highway 395 and a four-lane divided highway west of 395 which serves as the principal access to the Town of Mammoth Lakes from Highway 395. Traffic on Route 203 is typically light except during the winter ski season. Hot Springs Road is a very lightly traveled, two-laned, paved road maintained by Mono County which crosses the proposed project site. Access to the alternative power plant site would be along the unnamed dirt road past the SCE substation and to the site.

Visual Resources

The visual character of the project vicinity is dramatic and is one of the primary attractions for

visitors to the Mammoth Lakes area. There are several local nature areas with high-quality visual resources preserved for the enjoyment of the general public in the general area of the proposed project. In addition, the vegetation and wildlife of the region contribute to its high visual quality. Major viewpoints in the project vicinity are to the west, away from the proposed project site and toward Mammoth Mountain, the Minarets, San Joaquin Ridge, and Sherwin Bowl.

Both the proposed and alternate project sites are on gently sloping areas of primarily sagebrush scrub and scattered pine trees. The proposed project site is open to view by motorists traveling northeast on Route 203 east of Highway 395. The general project area is visible from portions of State 203 west of Highway 395, but the power plant site itself cannot be distinguished from adjacent areas at these distances. The portions of the project site are also open to view from Highway 395 from about 5,000 feet southeast of its junction with State Route 203 to within 1,000 feet of the junction. The alternative power plant site is not visible from Highway 395 or Route 203.

The clearest views of the proposed power plant site along Highway 395 are from the northbound travel lanes from about 4,400 feet southeast of its junction with State Route 203 to the junction. A long, low forested ridge to the north of the project site provides a backdrop, as viewed from Highway 395, that serves to minimize the visibility of individual features of the site and of the existing MP1 geothermal development northwest of the site.

SOCIOECONOMICS

The population of the Mammoth Lakes region has been steadily increasing over the last two decades. Most of the population of Mono County resides in the recently incorporated Town of Mammoth Lakes, which has a year-round population of approximately 5,000. Peak population on winter weekends reaches 35,000. Employment is concentrated in the government, retail sales, and service sectors, with service employment mostly generated by tourism.

Land Use

There are numerous land uses within the vicinity of the proposed project, including the existing

Mammoth Pacific I Geothermal Plant, Casa Diablo Substation, Mono County buildings, a liquid propane facility, Chance Ranch, Sherwin Creek Campground, Mammoth-June Lakes Airport, Forest Service Gravel Pits, Sierra Quarry, Hot Creek Hatchery, Old Mammoth School, Hot Creek Ranch, Shady Rest Campground, 115 KV electric transmission lines, and numerous roads throughout the project vicinity.

Economics

Mono County's economy is based primarily on recreation. Retail revenues are highly seasonal, peaking during the winter skiing season, with a secondary peak during July and August. Events and activities that negatively affect the skiing season (e.g., late or little snowfall or earthquake activity) dramatically affect the region's economy. There is an imbalance in the nature of the local economy due to its heavy reliance on recreational activities.

Fish and Game's Hot Creek Hatchery is important to the state's trout program. One of only three rainbow trout brood stock hatcheries in California, Hot Creek Hatchery provides approximately 20 million fish eggs for use in the state's year-round trout program and for use by hatchery systems of several other western states. Hot Creek Hatchery is also responsible for the production and planting of 700,000 catchable trout annually in the Inyo-Mono area and handles the major part of backcountry aerial planting in the northern Sierra Nevada.

Mono County receives revenues from a variety of sources. Total revenues for fiscal year 1985 to 86 were $13,517,524. The county expenditures for fiscal year 1985-86 equaled $13,517,824.

Community Services

The Mammoth School District provides local elementary and secondary education for the area. Law enforcement is provided by the Mono County Sheriff's Department headquartered in Bridgeport. The closest medical facility is the Centinela Mammoth Hospital located in the Town of Mammoth Lakes on Sierra Park Road. Local fire protection is provided by the Long ValleyFire Protection District. Street and road maintenance is provided by the county for all non-state and non-federal county roadways. The Mono County Water District operates a community sewage system and sewage treatment facility for residents of the Mammoth Lakes and the Lakes Basin areas. Mammoth Disposal Service, a private carrier, provides bin service on a contractual basis.

The site is located outside of the water service areas of the Town of Mammoth Lakes. A well which supplies non-potable water is located at the adjacent MP I site. The MP I plant receives electricity from the Southern California Edison Company. During 1986, the electrical substation serving the immediate area had a combined designed capacity of approximately 79 megawatts. The site area is currently served by the Continental Telephone Company (Contel) which has general offices and maintenance and switching facilities in Mammoth Lakes.

Hazardous Materials

Three 10,000-gallon gasoline storage tanks are located approximately one-quarter mile southeast of the project site, and an estimated 100,000 to 150,000 gallons of propane are stored in six tanks located about one mile east of the site. The existing Mammoth Pacific I geothermal power plant is located immediately adjacent to the proposed project site and stored about 20,000 gallons of isobutane as a working fluid for the binary geothermal heat extraction process.

Geothermal Resource Lease

The project area is located entirely on federally administered land within federal geothermal lease CA-11667. Pacific Energy assumed responsibility as agent for exploration activities within the lease from Santa Fe Geothermal on May 8, 1986. Assignment of title to the geothermal lease to Pacific Energy was approved by the BLM on June 1, 1986.

ENVIRONMENTAL CONSEQUENCES

The summary table of impacts and migration measures follows.

SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
AIR QUALITY								
Dust Generation	An estimated 16 tons per month of dust would be generated during construction. Project includes soil wetting, placing gravel on unpaved roads, and prompt revegetation and paving or covering of disturbed areas.	Limit speeds on dirt roads to 15 mph.	Estimated 18 tons per month of dust generated during construction. This alternative includes the same measures to reduce impacts as the proposed project.	Same as proposed project	Estimated 14 tons per month of dust generated during construction. This alternative includes the same measures to reduce impacts as the proposed project.	Same as proposed project	No construction would occur.	No mitigation is recommended.
Heavy Equipment Emissions	Diesel exhaust emissions would occur during grading and construction on 13 acres.	No mitigation is recommended.	Diesel exhaust emissions would occur during grading and construction on 15 acres.	No mitigation is recommended.	Diesel exhaust emissions would occur during grading and construction on 12 acres.	No mitigation is recommended.	No construction would occur.	No mitigation is recommended.
Hydrogen Sulfide Emissions	About one kilogram of H2S per hour would be vented to the atmosphere during short-term (2 to 4 hours) well testing and clean out of 8 wells. The project includes an H2S emergency plan.	No mitigation is recommended.	About one kilogram of H2S per hour would be vented to the atmosphere during short-term (2 to 4 hours) well testing and clean out of 9 wells. The project includes an H2S emergency plan.	No mitigation is recommended.	About one kilogram of H2S per hour would be vented to the atmosphere during short-term (2 to 4 hours) well testing and clean out of 6 wells. The project includes an H2S emergency plan.	No mitigation is recommended.	No well drilling would occur.	No mitigation is recommended.
	A spill of the entire production of geothermal fluid would release approximately 0.76 kilograms of H2S.	No mitigation is recommended.	A spill of the entire production of geothermal fluid would release approximately 0.91 kilograms of H2S.	No mitigation is recommended.	A spill of the entire production of geothermal fluid would release approximately 0.58 kilograms of H2S.	No mitigation is recommended.	No geothermal fluid would be used.	No mitigation is recommended.
Hydrocarbon Emissions	Fugitive emissions of isobutane (less than 750 lbs/day) would occur from leaks in the heat exchange system. Project includes leak detection program. The Great Basin Unified Air Pollution Control District would require the use of Best Available Control Technology if it were necessary to meet their permit conditions.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	Fugitive emissions of isobutane (less than 500 lbs/day) would occur from leaks in the heat exchange system; otherwise, this alternative is the same as the proposed project.	No mitigation is recommended.	No additional isobutane would be used or stored in the area.	No mitigation is recommended.
	A catastrophic rupture in the heat exchange system could release 20,000 gallons of vaporized isobutane which could form a flammable vapor cloud. Project includes a leak emergency plan.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	No additional isobutane would be used or stored in the area.	No mitigation is recommended.

SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
GEOLOGY AND SOILS								
Seismicity	Severe groundshaking would occur during a major seismic event.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	No new facilities would be built.	No mitigation is recommended.
			Ground rupture within the plant could cause ruptured geothermal or isobutane lines or collapse of structures.	Perform geophysical studies. Trench along any suspected fault. If found, date fault. Incorporate isolation valves at both ends of surface pipelines whcih cross active faults. Relocate power plant facilities sited on the fault.	Same as proposed project.	Same as proposed project.	No new facilities would be built.	No mitigation is recommended.
Shallow Geothermal Fluids	The likely presence of shallow hot water or steam could damage power plant facilities.	Perform borings to verify current water levels. If necessary, change grading plans or relocate power plant.	If shallow or surficial warm water exists, there could be hazards.	Perform borings to verify current water levels. If necessary, change grading plans.	Same as proposed project, except that smaller power plant could be moved west up to 80 feet and remain on the designated power plant site.	Same as the proposed project.	No new facilities would be built.	No mitigation is recommended.
Volcanism	If a major volcanic eruption occured, a catastrophic spill of geothermal fluids and/or isobutane could occur.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	No new facilities would be built.	No mitigation is recommended.
Subsidence	Surface subsidence could result from long-term geothermal production. Project includes construction of subsidence monuments to detect significant surface deformation.	No mitigation is recommended.	Surface subsidence could result from long-term geothermal production. These impacts would be greater than for the proposed project since 20% more fluid would be produced. Project includes construction of subsidence monuments to detect significant surface deformation.	No mitigation is recommended.	Surface subsidence could result from long-term geothermal production. These impacts would be less than proposed project because less fluid would be pumped. Project includes construction of subsidence monuments to detect significant surface deformation.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.
Erosion	Construction would disturb 13 acres. Erosion control measures are included in the project and required by the BLM and Lahontan Regional Water Quality Control Board. Runoff could be captured in the emergency spill containment basins to allow settling of sediments before flow reaches Mammoth Creek.	No mitigation is recommended.	Construction would disturb 15 acres. Erosion control measures are included in the project and required by the BLM and Lahontan Regional Water Quality Control Board. Erosion would affect a larger area and could impact the ephemeral lakes northwest of the alternative power plant site.	Construct berms to direct runoff leaving the power plant site so it would flow away from the ephemeral lakes.	Construction would disturb 12 acres; otherwise, this alternative is the same as the proposed project.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.

SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
Erosion (continued)	Closing the sluice gates on the emergency spill containment basins during construction could allow unnecessary accumulations of water resulting in damage to vegetation and "bathtub" lines if intermittent stream were flowing.	If the intermittent stream is flowing during construction, leave the sluice gates open unless there were an emergency which would call for its use.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	No emergency spill containment basins would be constructed.	No mitigation is recommended.
NOISE								
Construction Noise	Heavy equipment and traffic to and from the site would generate noise, but it would not be audible at the nearest sensitive receptors. Peoples and wildlife nearby would be temporarily affected.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No construction would occur.	No mitigation is recommended.
Operational Noise	The power plant would operate 7 days a week, 24 hours a day. The combined effect of the noise from MP I and PLES I would be about 3 decibels louder than MP I alone. Noise muffling devices are included the design. According to GRO Order No. 4, noise levels would not exceed 65dBA at the lease boundary or 0.5 mile, whichever is further.	No mitigation is recommended.	Noise generted at the alternate power plant site would not blend with noise from MP I because of the distance between the two power plants. A larger area would be impacted.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Noise levels would remain the same.	No mitigation is recommended.
WATER QUALITY AND HYDROLOGY								
Surface Water	Spills of geothermal fluid would be almost certainly contained in bermed areas or in the emergency spill containment basins. In the unlikely event that the roadbed at Route 203 failed and fluid reached Mammoth Creek, under extreme conditions of low stream flow and high ambient temperature, the temperature of the mixed water at the point of entry to Mammoth Creek could reach 118%F . This would cause mortality of fish and other aquatic organisms. Degradation of water quality would occur and could also harm aquatic organisms. The operator would stock the affected reach of Mammoth Creek.	A bioassay would be required in the Plan for Baseline Data Collection.	Same as the proposed project. The greater quantity of fluid required to operate at the alternative location be compensated for by the cooling and infiltration which would occur as the water flowed toward Mammoth Creek.	Same as the proposed project.	Impacts would be like those of the proposed project, except that due to the smaller volume of fluid pumped, the the mixed temperture in the extreme-case spill would be 100 F.	Same as the proposed project.	Spills from MP I which overflowed the bermed areas would flow to Mammoth Creek.	No mitigation is recommended.
Shallow Fresh Groundwater	Vegetation could be impacted if water is used for irrigation and sanitary uses.	Reduce groundwater pumping.	Slightly more groundwater would be used for irrigation of more landscaping and revegetation.	Same as proposed project.	Slightly less groundwater would be used than for the proposed project because of the smaller area	Same as proposed project.	Groundwater consumption would not increase at Casa Diablo.	No mitigation is recommended.

SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
WATER QUALITY AND HYDROLOGY (continued)								
Hydrothermal Resources	Simulated reservoir performance calculations using three different methods predict minor changes to reservoir pressure and temperature due to project operation. The project includes a comprehensive monitoring/mitigation program. One monitoring well has been drilled. The well would be monitored for baseline data. Potential migrations include a variety of reservoir management techniques which would first be triggered by observations in production and injection wells. Subsequent actions would occur, including the drilling of another monitoring well, based on analysis of monitoring results from a variety of natural features and wells. Ultimately, reduction or cessation of power production could be required to protect sensitive hydrothermal resources. If temperatures in Hot Creek headsprings change enough to deviate from their normal ranges, the operator would supply water from another source to allow continued operation of Hot Creek Hatchery and maintenance of the Owens tui chub habitat.	Change some trigger mechanisms (see Section 4.1.4.3.1 in the body of the EIS/ Supplemental EIR. Install a monitoring well near existing monitoring well SF 65-32 which would penetrate the injection reservoir. Before commercial power plant operation begins, require that a detailed program for timely implementation of remedial action measures to supply water to Hot Creek headsprings be approved by the authorized officer.	Same as proposed project, except that up to 20% more geothermal fluid would be pumped for the alternative location.	Same as proposed project.	Same as proposed project, except that 24% less geothermal fluid would be pumped for the smaller power plant alternative.	Same as proposed project.	PLES I could not impact hydrothermal resources.	No mitigation is recommended.
	If, contrary to all reasonable expectations, flow at Hot Creek Gorge fumaroles and springs were diminished by project operations, it would have less value as a geologic interpretive site.	Inject geothermal water upgradient of Hot Creek Gorge to restore flows.	Same as proposed project, except that up to 20% more geothermal fluid would be pumped for the alternative location.	Same as proposed project.	Same as proposed project, except that 24% less geothermal fluid would be pumped for the smaller power plant alternative.	Same as proposed project.	PLES I could not impact hydrothermal resources.	No mitigation is recommended.

SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT Impact	PROPOSED PROJECT Mitigation	ALTERNATE LOCATION Impact	ALTERNATE LOCATION Mitigation	SMALLER POWER PLANT ALTERNATIVE Impact	SMALLER POWER PLANT ALTERNATIVE Mitigation	NO-ACTION ALTERNATIVE Impact	NO-ACTION ALTERNATIVE Mitigation
BIOLOGICAL ENVIRONMENT								
Vegetation	Approximately 13 acres of sagebrush scrub and Jeffrey pine plant communities would be lost. The project includes vegetation protection meassures and extensive revegetation.	No mitigation is recommended.	Approximately 15 acres of sagebrush scrub and Jeffrey pine plant communities would be lost. Rhyolite buckwheat scrub would be disturbed by pipelines. Otherwise, this alternative would be the same as the proposed project.	Relocate injection pipelines to avoid rhyolite buckwheat scrub.	Approximately 12 acres of sagebrush scrub and Jeffrey pine plant communities would be lost. The project includes vegetation protection measures and extensive revegetation.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.
Terrestrial Wildlife	The habitat which would be lost is common in the region. No impacts to sage grouse, pygmy nuthatch, bald eagle, peregrine falcon, northern goshawk, Williamson's sapsucker, yellow warbler, hairy woodpecker, or special status animal species would occur.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.
	Noise may affect wildlife around the power plant, but no clear impacts can be defined.	No mitigation is recommended.	If noise impacts wildlife populations. the affect would occur over a larger area if the alternative power plant site were used.	Locate the power plant at the proposed site.	Same as for the proposed project.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.
Mule Deer	Approximately 70 deer were found to use the project area during the spring 1987 migration. They could be affected by pipelines, fencing, and the power plant. Does carrying fawns may be more vulnerable. The proposed project includes below-grade pipeline installation were appropriate. All fencing would be approved by the BLM.	New projects could contribute to off-site mitigation measures in proportion to their impacts.	Impacts to deer would be more severe for this alternative because a larger area would be disrupted and the pipelines would be longer.	Locate the power plant at the proposed site and contribute to off-site mitigation.	Same as for the proposed project.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.
Aquatic Resources	Impacts to aquatic resources are highly unlikely, as described in the hydrology summary. See that section for a discussion of impacts to water quality. The Lahontan Regional Water Quality Control Board has a variety of requirements to protect water quality. Fish would be restocked if mortality resulted from project activities.	A bioassay would be required in the Plan for Baseline Data Collection.	Same as for the proposed project.	Same as for the proposed project.	Same as for the proposed project.	Same as proposed project.	There would be no project impacts.	No mitigation is recommended.
Owens Tui Chub	The Owens tui chub, found in some of the Hot Creek headsprings, would be protected under the progressive monitoring/mitigation program described under hydrology.	See mitigations listed under hydrology.	Same as for the proposed project.	Same as for the proposed project.	Same as for the proposed project.	Same as proposed project.	There would be no project impacts.	No mitigation is recommended.

SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
SOCIAL ENVIRONMENT								
Cultural Resources	Construction and operations personnel could collect or disturb cultural artifacts.	Educate project personnel to the need to leave cultural remains undisturbed.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
	The injection pipeline would pass immediately adjacent to Cultural Resource Sites-7, -8, and -9. Careless use of equipment could damage the sites during laying of the line.	Flag the designated route before work begins and avoid during construction.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
	Subsurface resources may be encountered during construction. If such artifacts are found, construction would stop until suitable actions, approved by the Inyo Forest Supervisor, were taken.	No mitigation is rescommended.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
Native American Values	Traditional Native American interests often include areas around hot springs and fumaroles for their special soils and plants and for the springs themselves. Although no specific sites in the project area have been identified as sacred, Pacific Energy has indicated that continued access would be provided.	No mitigation is rescommended.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
Range	Approximately two AUMs would be lost to the permittee.	No mitigation is rescommended.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
Recreational Resources	In the highly unlikely event that the geothermal features at Hot Creek Gorge were reduced or depleted, a feature which accounts for 95,000 visitor days per year would be lost.	Inject geothermal water upgradient of Hot Creek Gorge to restore flows.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
	The trout-stocking program would be adversely affected if the hatchery could not function year-round.	See the discussion in the hydrology section.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.

SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
SOCIAL ENVIRONMENT (continued)								
Timber	Up to 40,000 board-feet of timber would be harvested. The site is not managed for timber production and is not included in the Inyo National Forest timber base.	No mitigation is recommended.	Up to 220,000 board-feet of timber would be harvested. Otherwise, impacts would be the same as for the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No timber would be harvested.	No mitigation is recommended.
Transportation and Access	Traffic impacts would be minor. If peak project traffic occurred during winter weekend traffic periods, project traffic would be routed to Hot Springs Road at Sherwin Creek Road, if necessary, thereby avoiding the busier Route 203 offramp from Highway 395.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No project impacts would occur.	No mitigation is recommended.
	Unpaved existing roads on the project site would be used for access.	No mitigation is recommended.	The power plant site would be reached by the unpaved dirt road leading to the SCE substation.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No project impacts would occur.	No mitigation is recommended.
Visual Resources	Drilling rigs would be visually strong but temporary elements. After wells were completed, they would be screened by vegetation.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No project impacts would occur.	No mitigation is recommended.
	The power plant would be the most visible element of the project, visible from Route 203 and northbound Highway 395. Existing and transplanted trees would mostly screen the power plant from view, but there would be narrow corridors through which the full 30-foot height of the condensers could be seen. The extensive landscaping, revegetation, and camouflage proposed as part of the project would reduce impacts. There would be no overhead electrical transmission lines. Exterior surfaces would be non-reflective to the extent feasible, exterior night lighting would be minimized, and natural terrain and vegetation would be used to provide visual screening.	No mitigation is recommended.	The power plant would not be visible from Route 203 or Highway 395. It could be seen from Antelope Springs Road, an unpaved road serving dispersed recreation in Little Antelope Valley.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Lanscaping of the area east of MP I where pipelines cross Hot Springs Road would not be done.	No mitigation is recommended.

SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
SOCIAL ENVIRONMENT (continued)								
Community Services	The number of students would increase slightly	The school district may assess fees on commercial development.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	No project impacts would occur.	No mitigation is recommended.
	No significant demands on law enforcement are expected.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No project impacts would occur.	No mitigation is recommended.
	Health care facilities would be adequate to treat all injuries excetp for severe burns or scalds. Local facilities are not equipped to handle such cases and they would be evacuated.	Revise local emergy response plans to include geothermal accidents. Train on-site personnel in CPR. Develop evacuation procedures for burn victims.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Similar burn accidents could occur at the MP I plant.	Same as the proposed project.
	The proposed project has a fire prevention and protection plan approved by the Long Valley Fire Protection District.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	Same as the proposed project.	No project impacts would occur.	No mitigation is recommended.
Street and Road Maintenance	Construction traffic may result in the need for additional maintenance or repair on county and Forest Service roads.	Transfer the cost of repairing damage caused by project activities to the operator. A performance bond could be posted or user fees assessed.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	No project impacts would occur.	No mitigation is recommended.
Wastewater, Soilid Waste, and Utilities	About 300 gallons per day of wastewater would be generated. Solid waste would be taken to the Benton Crossing landfill. Electricity would be bought from SCE if needed.	No mitigation is recommended.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	No project impacts would occur.	No mitigation is recommended.
Hazardous Materials	Some hazardous materials such as diesel fuel, paints, or solvents would be used and stored on the project site. Regional Water Quality Control Board requirement would be followed where applicable.	Follow proper procedures for use, storage, and disposal of all potentially hazardous materials.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	No project impacts would occur.	No mitigation is recommended.
Geothermal Resource Lease	The proposed project would result in the beneficial use of the geothermal resources within the federal geothermal lease.	No mitigation is recommended.	Same as the proposed project.	Same as the proposed project.	The reduction in output to 7 MWe would constitute a breach of the existing power agreement between the applicant and SCE and could result in termination of the project.	Approve the proposed project.	This alternative would prohibit development of the geothermal lease as currently proposed and could result in forfeiture of the lease.	Approve the proposed project.

SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
SOCIAL ENVIRONMENT (continued)								
Land Use and Planning	The proposed project would change the partially undeveloped character of the site to one of light industrial activity. The project is compatible with Forest Service plans and would not conflict with existing or planned uses in the area.	No mitigation is recommended.	Same as for the proposed project.	No mitigation is recommended.	Same as for the proposed project.	No mitigation is recommended.	No land use changes would occur.	No mitigation is recommended.
Employment, Population, and Housing	An average of 48 workers would be employed over the 9-month construction period, peaking with 82 workers in the fifth month. 16 full-time employees would operate the facility when commercial production begins. Outside workers could cause an increased demand for housing at the lower end of the price scale, potentially increasing housing prices.	Time construction to avoid having the peak construction housing needs coincide with the peak winter housing demand.	Same as for the proposed project.	Same as for the proposed project.	Same as for the proposed project.	Same as for the proposed project.	No project impacts would occur.	No mitigation is recommended.
Economics	The local economy would benefit from the payroll paid to workers, which would be similar to the MP I payroll ($451,000 in 1986), and from plant purchases. The year-round operation of the plant would help stabilize the highly seasonal nature of employment and retail sales.	No mitigation is recommended.	Same as for the proposed project.	No mitigation is recommended.	Same as for the proposed project.	No mitigation is recommended.	The community would forego the economic benefits of the project.	No mitigation is recommended.
	In the highly unlikely event that water temperature changes at Hot Creek Hatchery prevented year-round operation, the hatchery would lose eggs worth up to $16,000 annually at current market rates. In addition, a major portion of the facilities for backcountry aerial planting would have to be moved to other hatcheries. The power plant operator is obligated to supply water to the hatchery so that normal operations can be maintained.	See mitigations described in the hydrology section.	Same as for the proposed project.	No mitigation is recommended.	Same as for the proposed project.	Same as for the proposed project.	No project impacts would occur.	No mitigation is recommended.
	County revenues would increase by about $250,000 per year from property taxes, sales taxes, and a portion of the geothermal lease.	No mitigation is recommended.	Same as for the proposed project.	No mitigation is recommended.	Lower revenues would be generated by the proposed project.	No mitigation is recommended.	The community would forego the economic benefits of the project.	No mitigation is recommended.

1.0 INTRODUCTION

Pacific Energy of Commerce, California has proposed the development of a geothermal wellfield and the construction and operation of a 10 MWe (net) geothermal power plant on federal land administered by the Inyo National Forest in Mono County, California. The U.S. Bureau of Land Management (BLM), as the applicable mineral resource management agency, and pursuant to federal regulation (43 CFR 3261.3), is lead agency with respect to compliance with the National Environmental Policy Act (NEPA) of 1969. The Great Basin Unified Air Pollution Control District is lead agency for compliance with the California Environmental Quality Act (CEQA).

The purpose of this document is to analyze the impacts of the four alternatives, including the proposed project, so that decision-makers will have adequate information on which to base their decision to approve the PLES I proposed project or one of the other alternatives. The decision will be made using the findings presented in this Environmental Impact Statement / Environmental Impact Report Supplement (EIS/SEIR).

The EIS/SEIR is divided into three major sections in addition to the introductory and supporting material. Proposed Action and Alternatives (Chapter 2), contains a description of each alternative. Chapter 3 describes the environment, resource by resource, which would be affected by the actions. Environmental Consequences, included as Chapter 4, is also organized by resource. For each resource, an impact and mitigation analysis is included for each alternative. A discussion of the nature of the potential impact is given. Features of the proposed project, the alternative location, and smaller power plant which serve to reduce impacts are identified and mitigation measures are enumerated along with an assessment of their likely effectiveness and a brief discussion of impacts which might result from their implementation. Cumulative impacts are discussed in this chapter as well.

1.1 BACKGROUND

The PLES I project was first formally proposed when Pacific Energy (then named Pacific Lighting Energy Systems) submitted a Plan of Operation for the project to the BLM in September 1986. On the basis of the likely significance of expected impacts from the project, a

joint decision between BLM, U.S. Forest Service (Forest Service), and the Great Basin Unified Air Pollution Control District was made to prepare an Environmental Assessment/ Environmental Impact Report (EA/EIR) to satisfy the provisions of NEPA and the California Environmental Quality Act (CEQA). The Great Basin Unified Air Pollution Control District, a local agency with discretionary permit authority for the proposed project, is lead agency under CEQA. The chronology of events in the environmental review process culminating in the decision to prepare an EIS/SEIR for the project is as follows:

September 3, 1986	Plan of Operation for PLES I project was submitted to Bishop Resource Area (RA).
October 21, 1986	Bishop RA conducted a public site inspection.
November 15, 1986	Comment period on PLES I plan closed.
November 25, 1986	Proposal was issued to contract for preparation of joint EA/EIR.
August 19, 1987	Joint Draft EA/EIR was distributed for public review and comment.
September 15, 1987	Public hearing on Draft EIR was held in Mammoth Lakes.
October 9, 1987	Comment period on PLES I Draft EA/EIR closed.
October 14, 1987	Sierra Club submitted a protest to BLM California State Office (CSO).
February 10, 1988	U.S. Fish and Wildlife Service, after a Section 7 Consultation regarding the Owens tui chub, issued a "No Jeopardy Opinion."
February 11, 1988	Bishop RA and Inyo N.F. approved the PLES I project.
February 26, 1988	CSO dismissed Sierra Club protest.
March 9, 1988	California Department of Fish and Game (Fish and Game) appealed the decision of the Bishop RA.
March 9, 1988	Bishop RA approved the PLES I Plan for Baseline Data Collection.
March 11, 1988	Sierra Club et al. also appealed BLM decision.
March 31, 1988	BLM CSO requested an expedited Interior Board of Land Appeals review.
April 8, 1988	Fish and Game appealed the BLM approval of the PLES I Plan for Baseline Data Collection.
May 2, 1988	BLM and Fish and Game met in Sacramento to discuss Fish and Game concerns.

May 12, 1988 Sierra Club et al. and Fish and Game filed their Statement of Reasons with BLM.

May 23, 1988 BLM and Fish and Game met in Bishop to discussed the specific concerns identified by Fish and Game.

May 24, 1988 Final EIR was certified.

May 31, 1988 BLM staff from CSO and solicitor met to evaluate Fish and Game and Sierra Club Statement of Reasons. The decision to require an EIS was made.

June 23, 1988 BLM sends out public notice of the July 8, 1988 public scoping meeting and site visit to identify specific issues and concerns for analysis in the PLES I EIS.

July 8, 1988 BLM conducts public scoping meeting and site visit of the PLES I project area.

August 30, 1988 Memorandum of Understanding between BLM and Great Basin Unified Air Pollution Control District to prepare a joint EIS/SEIR

Sept. 9, 1988 Public notice in Federal Register of the availability of the PLES I Draft EIS No. 880294.

Oct. 21, 1988 The Great Basin Unified Air Pollution Control District conducts a Public Hearing on the Supplemental EIR for the PLES I Project.

The decision to require an EIS is not based on the belief that the Joint EA/EIR incorrectly assessed the significance of impacts but on the fact that public controversy persists regarding potential impacts of the project on surface hydrothermal features in the area. The introduction of a report on the project's potential hydrothermal impacts in Fish and Game's Statement of Reasons has increased concern over the potential impacts to Hot Creek Hatchery and Hot Creek Gorge. Accordingly, the BLM has determined that the threshold of "significance" for controversy as defined in 40 CFR §1508.27(b)(4) which would require preparation of an EIS for the project has been crossed.

The EIS deals with two alternatives, including an alternative power plant location, which were not analyzed in the Joint EA/EIR. There are also a number of measures to reduce impacts which are included in the currently proposed project but were not part of the project analyzed in the Joint EA/EIR. Many of these measures, developed since the Joint EA/EIR was published, would serve to lessen visual impacts and to improve the monitoring/mitigation plan for hydrothermal resources. Because of these factors and in accordance with CEQA Guidelines, Section 15163, Great Basin Unified Air Pollution Control District has determined that the EIS should serve as an EIR Supplement to the Final EIR certified May 24, 1988. A Memorandum of Understanding to that effect between the BLM and Great Basin Unified Air Pollution Control District was signed August 30, 1988.

1.2 PURPOSE AND NEED FOR ACTION

The Plans of Operation for Development, Utilization and Injection, submitted by Pacific Energy, were received by the BLM on September 8, 1986, and describe the purpose of the project, which is to develop and utilize geothermal resources believed to exist within federal geothermal lease CA-11667. Toward this end, Pacific Energy proposes to drill and test geothermal wells, pump the subsurface geothermal fluids to the surface, extract heat from the produced fluids, convert that heat into electrical energy in a 10 MWe (net) binary-cycle power plant, and inject the cooled fluid to a subsurface injection reservoir.

The need for the project was stated by the U.S. Congress in the Geothermal Steam Act of 1970, the Mining and Minerals Policy Act of 1970, the Federal Land Policy and Management Act of 1976, and the National Materials and Minerals Policy, Research, and Development Act of 1980. These acts direct the Federal Government to foster and encourage private enterprise in the development of alternative energy resources within appropriate environmental constraints. Towards this end, each federal geothermal lessee is required to perform "... diligent exploration until there is a well(s) capable of commercial production on the leased lands." (43 CFR 3203.5). The lessee is also required to commercially produce or utilize the geothermal resource within ten years of the lease issuance or forfeit the geothermal lease. Federal policy encourages the use of alternate energy resources, such as the geothermal resource at Casa Diablo because unlike an electrical generation facility which utilizes oil, gas, coal or other fossil fuels, the PLES I geothermal facility would utilize a clean, domestic energy resource, natural

hot water, that would not produce stack emissions, such as carbon monoxide, nitrogen oxides, or particulates, which are produced by fossil fueled facilities. This energy resource would not, therefore, impact or produce emissions which would impact the Earth's ozone layer or add to the generation of photochemical smog. Also, the electricity produced by this facility would utilize an energy resource which is not dependent on foreign sources, unlike a significant percentage of the oil and gas utilized by this nation. The utilization of any alternate domestic energy resources would reduce this nation's energy dependence on foreign countries and strengthen our national security.

1.3 PROJECT LOCATION AND STUDY AREA

The project is proposed for federal geothermal lease CA-11667, located in Geothermal Lease Block I within the Mono-Long Valley Known Geothermal Resource Area (KGRA). This 1,510-acre lease, shown on Figure 1-1, is located on land within the Inyo National Forest, three to four miles east of Town of Mammoth Lakes, Mono County, California. This area is in the southwestern part of the Long Valley Caldera, in the Mammoth Creek drainage basin.

In the EIS/SEIR, several terms are used to describe the area around the project, with varying degrees of specificity.

Proposed project site refers to the smallest area. It includes the production and injection fields and the power plant site, shown on Figure 1-1.

The project area includes the project site, all of federal lease CA-11667, and the private and federal property enclosed within it. The project area is generally the same as the Casa Diablo area.

The project vicinity includes the Mammoth Creek drainage basin.

1.4 MAJOR ISSUES

1.4.1 ISSUES ANALYZED IN THE EIS

During the earlier environmental review of the proposed project and in response to the Notice of Preparation for the EIS, attention was focused on a few major issues: thermal springs, particularly those at Hot Creek Hatchery and Hot Creek Gorge; the Hot Creek/Mammoth Creek fishery and other aquatic organisms in the area; hydrologic monitoring; visual resources; and mule deer. Cumulative impacts of the proposed PLES I Project and other developments in the vicinity of the project area were also raised as a major issue.

1.4.1.1 Thermal Springs

Potential impacts to the thermal features are a major issue. Thermal water contributes to flows at several springs in the Casa Diablo/Hot Creek area including those at Hot Creek Gorge, a geological interpretive area, and those springs supplying Hot Creek Hatchery operated by Fish and Game. Hot Creek Gorge and Hot Creek Hatchery are important to the recreation-based economy of the region, in addition to their intrinsic value. Fish and Game has also raised the issue of snails and other aquatic invertebrates which may live in thermal springs and how they might be affected if the thermal contribution were changed. Issues regarding potential adverse impacts to thermal springs are discussed along with the related issue of the potential for geothermal reservoir pressure and temperature change.

1.4.1.2 Surface Water Contamination

Another major issue is the potential for spills or erosion from the project site which could cause damage to the Mammoth/Hot Creek fishery. Hot Creek is a nationally-known, catch-and-release, trophy trout stream and its protection is very important. This includes protection of the invertebrates and stream vegetation which provide food and shelter for the fish. The concern is that thermal and/or chemical degradation of the stream could result from accidental spills of geothermal fluids.

1.4.1.3 Hydrologic Monitoring

Issues were raised concerning specific monitoring methods; determination of critical reservoir

Proposed Project Site

Project Area

Project Vicinity

Note: The Project Vicinity extends to the Sierra Crest in the southwest.

FIGURE 1-1
PLES I, Project Vicinity,
Lease CA-11667, and Project Site

parameters triggering remedial action; and the feasibility, potential effectiveness, and environmental consequences of proposed mitigation measures.

1.4.1.4 Visual Resources

Visual quality is highly valued in the region. People have expressed concern that the presence of an additional geothermal power plant would be visually intrusive and would have a detrimental effect on visitors and residents.

1.4.1.5 Mule Deer

Mule deer are abundant in Mono County and there is concern that development along the eastern side of the Sierra Nevada may jeopardize habitats and routes of migration crucial to the continued vitality of local deer herds.

1.4.1.6 Cumulative Impacts

Cumulative impacts are effects on the resources of an area or region caused by the combination of existing developments and uses along with proposed and reasonably foreseeable development. The major issues for the cumulative impacts analysis are the same as those described above for the project impacts analysis. The cumulative analysis in the EIS generally assesses impacts based on the development scenario described in Appendix F and discusses the relative contribution of the proposed project to the total cumulative impact.

1.4.2 ISSUES CONSIDERED BUT NOT FURTHER DISCUSSED

Extensive geothermal power generation occurs at the Geysers, a KGRA located largely in Sonoma and Lake Counties in northern California. During review of the Joint Draft EA/EIR, a number of commentors suggested that environmental impacts at the Geysers should be used to evaluate potential impacts on the project area. There are two major reasons the Geysers experience is not particularly relevant: topography and air cooling of the working fluid. Siltation of salmonid spawning gravels and decreased food production in the form of benthic invertebrates are of particular concern at the Geysers. The steep slopes characteristic of the area are susceptible to erosion and landsliding and spills travel rapidly on the steep slopes. In addition, a great deal of earth moving, especially cut-and-fill is required by the topography of the

Geysers in order to construct drill pads, access roads, and power plant sites. In contrast, the topography of Casa Diablo is gently sloping with very little cut-and-fill needed. Also significantly, the depth of the wells at the Geysers requires drill pads much larger than is needed for the shallow wells at Casa Diablo and the power plants at the Geysers are much larger than that proposed at Casa Diablo. The amount of surface disturbance at the Geysers is therefore many orders of magnitude larger than at Casa Diablo and is not realistically comparable. This impact would be much less severe at Casa Diablo because the topography is gently sloping and there are fewer perennial streams to be affected.

Spills at the Geysers have been primarily geothermal steam condensate from cooling towers and chemicals being transported to the plant sites. Condensate spills accounted for 82% of the spills from 1974 to 1984. About 2% of the spills were materials used for H_2S abatement and in the treatment of condensate (Warner et al., 1986). Therefore, over 80% of the spills are related to water cooling. At PLES I the geothermal fluid would be circulated in a closed system and the working fluid would be air cooled, so there would be no condensate nor would treatment of it be necessary.

1.5 RELATIONSHIP TO FEDERAL AND LOCAL PLANS, POLICIES, AND PROGRAMS

1.5.1 BLM

The BLM is the agency responsible for management of geothermal resources on federal geothermal leases and enforcement of the provisions of the Geothermal Steam Act of 1970, 43 CFR 3200 regulations, and associated operational orders. The BLM is the designated federal lead agency under NEPA for preparation of this EIS. In addition, the BLM has a Mineral Resources Policy which reflects the provisions of the Mining and Mineral Policies Act of 1970, the Federal Land Policy and Management Act of 1976, and the National Materials and Minerals Policy, Research and Development Act of 1980. The BLM, under these laws, is responsible for making public lands available for and encouraging orderly and efficient development of energy resources under principles of environmental protection and multiple-use management. BLM policies must be consistent with Forest Service, state, and local plans. The proposed project is consistent with federal law, regulation, planning, and policy.

1.5.2 INYO NATIONAL FOREST

The Land and Resource Management Plan establishes policies and management direction in

determining the appropriateness of geothermal energy development on lands under Forest Service jurisdiction. In evaluating applications for geothermal development, the Forest Service participates jointly with the BLM in an environmental analysis to estimate the impacts of geothermal activity and recommends mitigation measures to minimize those impacts.

Lease CA-11667 is located in two Management Areas: #7, the Upper Owens River and #9, Mammoth. Direction for managing these areas is incorporated in Forest-wide Standards and Guidelines, Management Prescriptions and Management Area direction. The Forest-wide Standards and Guidelines for management of the geothermal resource state:

- Provide for the leasing of National Forest lands for exploration and development of oil, gas and geothermal resources commensurate with other resource values. Follow existing Memoranda of Understanding between the Bureau of Land Management and the Forest Service that relate to oil, gas, and geothermal mineral activities. Follow applicable regulations, operating orders, and notices for oil, gas, and geothermal leases issued pursuant to appropriate authority.

- Prepare environmental documents that analyze full-scale development prior to consenting to Bureau of Land Management's issuance of geothermal leases.

- Prepare postlease environmental documents in cooperation with the Bureau of Land Management for site-specific exploration, development, and production proposals. Assure that impacts to resources are appropriately analyzed. Assure that impacts to resources are mitigated to the extent possible.

- Consider the location of fluid conveyance lines and facilities for geothermal development to ensure the viability of deer migration corridors. Encourage geothermal development that utilizes air cooling rather than evaporative cooling systems.

1.5.3 MONO COUNTY

The Mono County General Plan includes a Geothermal Element which was adopted in 1982 and a supporting EIR. The Geothermal Element was prepared by the Inyo-Mono Association

of Governmental Entities (IMAGE), the regional planning agency for the Inyo and Mono Counties and the City of Bishop. Currently, adopted County policy in the Geothermal Element encourages geothermal development.

The county does not have jurisdiction over development on federal lands. However, they may recommend reasonable environmental constraints. The county approved construction of a seven MWe binary power plant in 1982. Due to the visual, noise, air quality, and potential hydrological and biological impacts of this initial geothermal power plant, and changes in the political climate, Mono County is reconsidering its policies on geothermal development. The county is preparing a new Energy Element of the General Plan which would include new policies on geothermal resources. The intent of the new Energy Element is to adopt energy policies consistent with other county policies. The Administrative Draft Energy Element is currently under review by the county.

1.5.4 TOWN OF MAMMOTH LAKES

The Town of Mammoth Lakes General Plan established a planning area boundary beyond the town limits, pursuant to Government Code Section 65300. The planning area includes areas where existing or proposed facilities have a direct relationship to the current town boundaries. The eastern boundary of the planning area lies between Highway 395 and Crowley Lake. The PLES I Project site itself is adjacent to and directly east of the town's planning area boundary. The town's General Plan (Mammoth Lakes, Town of, 1987) states that cooperative planning in this extraterritorial planning area will help establish consistency in development standards, promote orderly and efficient extension and expansion of community facilities and services, and will clearly identify the town's continued interests and involvement in the area. According to this policy, the town desires to be consulted and pursue cooperative planning in developing lands within the extraterritorial planning area, which includes the PLES I site. The Town of Mammoth Lakes has participated in Forest Service planning and environmental review. The town does not have jurisdiction over actions within its extraterritorial planning area. However, the goals, policies and actions of the General Plan state the policies the town would use in reviewing development outside the town boundary but within the planning area. The town will use General Plan goals and policies on land use, open space, scenic, flood hazard and noise, as well as plans on adjacent land within the town limits, to evaluate the PLES I Project. Directly adjacent to the west of the PLES I site is the area called Urban Planning District 10 - Gateway, which means it is the gateway or entry to the Town of Mammoth Lakes and is the town's

eastern boundary. Land uses within Gateway are designated for general open space and Open Space / Institutional / Public Facilities. Maintaining scenic views is a priority in this area.

Two other Urban Planning Districts area located outside town limits but within the planning area. The town has made plans for these districts as a statement of town policy. About three miles southwest of the proposed site is the proposed Sherwin Bowl Ski Area, which is located within Urban Planning District 14. Sherwin Bowl, which is subject to approval by the Forest Service, is proposed to accommodate 8,000 skiers-at-one-time. In addition to downhill ski facilities, nordic and snow play areas are also proposed. The town has designated the area for open space, which allows active and passive recreation development and supports commercial uses. A Draft EIS is currently being circulated for public review. San Joaquin Ridge Planning District 17, about five miles northwest of the proposed site, is designated for open space and allows recreation activities.

1.6 AUTHORIZING ACTIONS

Discretionary approvals and permits from several agencies would be required for the project. These are summarized in Table 1-1. This EIS/SEIR has been prepared under NEPA Guidelines in response to BLM and Forest Service requirements and under CEQA Guidelines in response to California requirements. The original EA for the project also served as the EIR (SCH #86122913), with the Great Basin Unified APCD serving as Lead Agency for CEQA. The EIR was certified on May 24, 1988.

1.7 ENVIRONMENTAL COMPLIANCE MONITORING

Recently enacted California legislation requires that a monitoring or reporting program be developed to ensure that mitigation measures to reduce the significant or potentially significant impacts are carried out. No significant impacts have been identified for the PLES I Project, in large measure due to the inclusion as part of the project of a number of features which serve to reduce project impacts to insignificance. Although one could argue, therefore, that California would not require monitoring in this case, the authorized officer in carrying out his duties would function as the environmental compliance monitor in verifying that the features of the project included to reduce impacts are carried out.

TABLE 1-1: PERMITS AND APPROVALS

Agency	Permit/Approval	Facility
Great Basin Unified APCD	Authority to Construct	Power plant; all wells
	Permits to Operate	Power plant; all wells
California RWQCB, Lahontan Region	Waste Discharge Orders	Power plant; all wells
Bureau of Land Management	Plan of Exploration	Exploration wells, roads, drill pads
	Plan of Development	Production wells, roads, drill pads
	Plan of Injection	Injection wells, roads, drill pads
	Plan of Baseline Data Collection	Facilities necessary for the collection of baseline data
	Plan of Utilization	Power plant, pipelines, power lines
	Plan for Production	Production procedures and monitoring for royalty assessment

SOURCE: Thomas, T., 1987.

2.0 PROPOSED ACTION AND ALTERNATIVES

This chapter describes alternatives which are analyzed and those which were considered but dismissed. The proposed project site was the alternative site analyzed in the PLES I Joint EIR/EA and is presented as the proposed project in this EIS/SEIR a result of the earlier analysis. The alternative location for the power plant was chosen in order to fully mitigate the visual impacts from Highway 395 associated with the proposed power plant. The smaller power plant alternative was selected by removing one of the three proposed generators. The no-action alternative is required by NEPA regulations.

Two alternatives which are not being analyzed in this EIS/SEIR are the power plant located adjacent to MP I, which was originally proposed in September 1986, and a solar-powered electricity facility located outside Long Valley Caldera.

The PLES I Joint EA/EIR analyzed a project which would have been located immediately adjacent to the existing MP I power plant and within the PLES I production field. The BLM and Forest Service selected an alternative which is the same as the proposed project in this EIS/SEIR. The analysis in the Joint EA/EIR clearly identified the originally proposed site as having greater impacts to visual resources with few concomitant benefits. It has been dropped in favor of the currently proposed project.

In the public scoping meeting for the EIS/SEIR, it was suggested that the alternative of using solar generated electricity "from somewhere else in SCE's service area" be analyzed. This alternative is not being considered in this analysis because the basic action under consideration by the BLM is not the generic generation of electrical energy, but the appropriate development of the federal geothermal lease. The federal geothermal lessee has been granted the exclusive rights to explore, develop, and produce geothermal resources from this lease and has an obligation under the terms of the lease to diligently pursue production of these geothermal resources under approval which must be obtained from the BLM. The BLM must evaluate and consider the environmental consequences of any proposal and may determine not to approve a proposed action because of its environmental consequences, but any alternative which does not consider the development of the geothermal lease becomes functionally equivalent to the no-action alternative.

In summary, the four alternatives selected for analysis are:

- the proposed project, a 10 MWe (net) binary power plant and supporting well field;
- the alternate power plant location, a 10 MWe (net) binary power plant sited in a different part of the lease using the same well field;
- the smaller power plant, a seven MWe (net) binary power plant on the site of the proposed project; and
- the no-action alternative.

A summary comparison of their general characteristics is shown in Table 2-1. The BLM in cooperation with the Forest Service has identified the proposed project as the preferred alternative.

TABLE 2-1: SUMMARY COMPARISON OF ALTERNATIVES/a/

	Proposed Project	Alternate Location	Smaller Alternative
Power Output (net) MWe	10	10	7
Power Plan Footprint (acres)	5.1	5.6	4.5
Generators (#)	3	3	2
Heat Exchangers (#)	9	9	6
Air Coolers (#)	40	42 to 44	30
Production Wells (#)	4	4 or 5	3
Production (gpm)	5,000	6,000	3,800
Length of Gathering Pipeline (feet)	2,600	4,200	2,400/c/
Length of Injection Pipeline (feet)	1,700	4,500	1,500/d/
Disturbed Area (acres)	13/b/	15	12

/a/ The no-action alternative would have none of the components listed above.
/b/ Taken from information provided to the BLM by Pacific Energy.
/c/ Assumes production well SF 35A-32 is not drilled.
/d/ Assumes injection well SFI 54A-32 is not drilled.

SOURCE: Pacific Energy and Environmental Science Associates, Inc.

2.1 PROPOSED ACTION

The project area is within the Long Valley KGRA, immediately adjacent to the existing seven MWe (net) Mammoth-Pacific I geothermal resource electric generating facility (MP I). There are no other existing geothermal projects in the project vicinity.

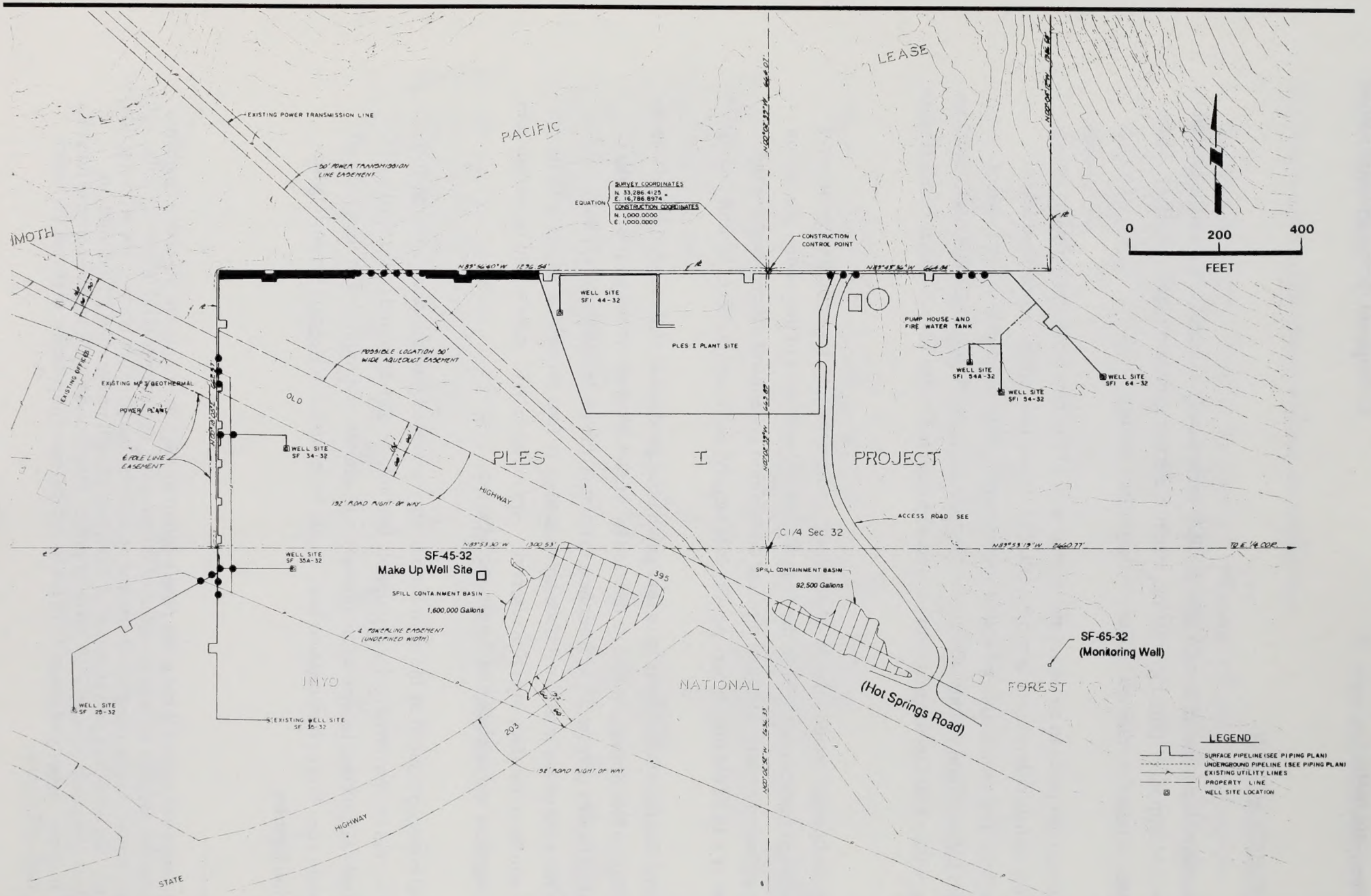
Pacific Energy proposes to construct and operate a 10 MWe (net) binary power plant and geothermal wellfield development project (PLES I Project) on federal geothermal lease CA-11667./1/ The project area is located approximately three miles east of the Town of Mammoth Lakes, Mono County, California (Section 32, T.3S., R.28E., MDB&M) and is within the Long Valley East Geothermal Unit on land administered by the Inyo National Forest (Figure 2-1).

The proposed project would include: the drilling, construction, and operation of geothermal production and injection wellfields; the construction and operation of the related production pipeline gathering system; injection pipeline distribution system and the construction and operation of a 10 MWe (net) binary power plant facility; and construction of control facilities.

Geothermal fluid, produced from up to four geothermal production wells located in the vicinity of Casa Diablo Hot Springs, would be directed by surface pipelines to the proposed binary power plant facility (Figure 2-1). After heat extraction, the cooled geothermal fluid would be directed from the power plant by surface pipeline to up to four geothermal injection wells and injected into the subsurface injection reservoir. Approximately 13 acres would be disturbed in the development and operation of the proposed project.

Electrical energy produced by the utilization facility would be directed to on-site transformers. There it would be converted to the appropriate line voltage and delivered to the existing SCE Casa Diablo Substation, located approximately one-quarter mile northwest of the proposed power plant site. Power transmission lines would be mounted on sleepers supporting the production pipeline.

/1/ The net power output is the gross power output of the plant minus the so-called "parasitic" uses within the facility, such as power used for pumping geothermal fluid to and from the wells. The gross power output is highly dependent on ambient temperature because the working fluid is air cooled. On cold days power output is much higher than on hot days, Therefore, the contractual obligation to supply 10 MWe of power year-round would require construction of a plant with gross capacity of about 15 MWe to compensate for parasitic uses and the lower summertime efficiency.



Trenched Piping

Buried Piping

Spill Containment Basin

SOURCE: Pacific Energy

FIGURE 2-1

Proposed Project Site Plan

2.1.1 MEASURES INCORPORATED AS A RESULT OF PREVIOUS PROJECT APPROVAL

The project applicant has incorporated as part of the project description, all of the stipulations of the previous BLM Decision Record on the PLES I Project, dated February 11, 1988. To the degree possible, these stipulations are consistent with conditions drafted by Mono County for the proposed Mammoth Pacific II and III Projects. These stipulations are reproduced below:

1. Permanent structures shall be less than 32 feet in height as measured from final grade.
2. All facilities shall be designed to avoid areas of potential slope instability, ground rupture and withstand reasonable seismic accelerations and offsets. An engineering/geotechnical analysis may be required to identify potential hazards.
3. The power plant site, well pads, pipelines, and access roads, will avoid mature trees whenever possible.
4. Pipelines:
    a) Pipelines shall be sited as far north and west as practical to maximize screening by natural vegetation and terrain.
    b) Pipelines shall be built as close to the ground as possible.
    c) The authorized officer may require burial (covering) or screening of segments of the pipeline as appropriate.
5. Roads:
    a) Construct and maintain all roads to USFS Standards. Standards such as width, cut/fill slope design, and surfacing requirements will be addressed on a case by case basis.
    b) No road construction will be permitted for pipeline construction.
6. Fire and Safety
    a) Construct all hydrocarbon storage and utilization facilities in conformance with applicable industry standards and in compliance with applicable fire and safety codes.
    b) Keep potential ignition sources away from the hydrocarbon accumulator and storage tanks areas, the power plant site drainage courses, and the catchment basin.
    c) Post "no smoking" and "flammable liquid" signs in all areas except areas specifically designated as smoking areas.

d) Prepare and review emergency fire and spill contingency plans with local fire fighting authorities.

7. No offroad vehicle or equipment travel will be permitted outside of approved construction areas and access routes.

8. To the extent possible, construction traffic should be routed to avoid the route 203/395 interchange on weekends during the winter ski season.

9. Electrical transmission lines will be screened from view from the south and west.

10. Should a vapor cloud be generated during flow testing which could cause hazardous driving conditions, the authorized officer will limit flow testing until weather conditions improve.

11. Maximize cut and minimize fill in leveling the plant site to reduce the overall height of the power plant facilities.

12. Approval for noise intensive activities may be limited from April 15 through June 15 and October 15 through November 1 of each year (during deer migration).

13. Fencing of areas or facilities will require approval by the authorized officer.

14. Water and erosion control measures will be required for all surface disturbance in conformance with USFS Best Management Practices.

15. Should operation under this plan cause significant fish kills, as determined by the authorized officer, the operator will restock the affected fishery(s).

16. To the extent compatible with engineering considerations, all exterior surfaces shall be of rough texture, with no reflective metal or glass surfaces oriented toward the south or west.

17. All permanent facilities shall be neutral earth-tone colors approved by the authorized officer.

18. Exterior structural lighting shall be minimized and shielded from view from the south and west. Work lights should be equipped with switches or timers to minimize continuous use.

19. Emergency shutdown systems will be designed to prevent large spills of geothermal or secondary working fluids. A testing/maintenance/inspection schedule will be established prior to production. The shutdown system and the testing/maintenance schedule will be developed in accordance with GRO #6.

20. Construct and maintain a one (1) foot minimum berm within the power plant site capable of containing a geothermal spill. The bermed area shall drain to a catchment basin which must be capable of containing a spill of at least 25,000 gallons. The catchment basin size must take into consideration lost capacity resulting from the collection of rain water or snow melt. The basin overflow structure will be designed to minimize erosion.

21. The authorized officer shall be notified immediately in the event of a blowout, or spill or discharge of any significance. Containment and/or cleanup will be determined on a case by case basis.

22. Develop a hydrogen sulfide (H_2S) emergency contingency plan for well drilling and testing operations. The plan will include detection monitoring, training, and emergency response actions for reacting to unsafe concentrations of H_2S.

23. The following mitigation process will be used to mitigate potential hydrothermal impacts on the Owens tui chub and may be modified as appropriate to mitigate impacts to Hot Creek Fish Hatchery and Hot Creek Gorge springs:

    a) The operator shall be responsible for reporting to the authorized officer the monitoring measurements required to be collected by the Plan for Baseline Data Collection (PBDC) approved for the project, or any other monitoring data which may be required by the authorized officer. The approved PBDC will incorporate the monitoring program recommended for the project by the Long Valley Hydrologic Advisory Committee (LVHAC) dated October 1987, as corrected, and shall require monitoring information be collected and reported for the C-D Hot Creek headsprings comparable to that recommended by the LVHAC for the A-B Hot Creek headsprings which is Critical Habitat for the endangered Owens tui chub.

    b) The authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub, will evaluate the monitoring data and consult with the U.S. Geological Survey, the California Division of Oil and Gas, the County of Mono, and the U.S. Fish and Wildlife Service, if appropriate (the "consulting agencies"), regarding the analysis of the data and the development of mitigating measures as indicated appropriate by the conclusions of the analysis of the data.

    c) If the authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub, determines a need to supplement monitoring information developed from existing Monitoring Well 65-32, a second monitoring well may be required to be drilled, maintained, and monitored in conformance with the requirements of Stipulation 23(a) (above). The well shall generally be located in the area of Colton Springs, with the specific location to be determined by the authorized officer and the appropriate governmental agencies with land use jurisdiction. The authorized officer may also require mitigation actions in addition to the second monitoring well including, but not limited to, one or more of the following actions:

        (1) Temporarily modify the production or injection of geothermal fluids within the field and monitor the reservoir response. Modification could include one or more of the following:

            (i) Change fluid volumes or pressures in one (1) or more wells;

            (ii) Discontinue use of one (1) or more production or injection wells; or

            (iii) Relocate one (1) or more production or injection wells.

        (2) Permanently modify the production/injection program.

    d) If the authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub, determines that monitoring information from the second monitoring well (located near Colton springs) and all other monitoring information indicated a need for further information with respect to a threat posed by plant operations to beneficial uses of thermal water, or to the continued existence of

the Owens tui chub, the Authorized Officer may require that a third monitoring well be drilled, maintained, and monitored in conformance with the requirements of Stipulation (a) (above). The well shall generally be located in the area between Colton springs and the Hot Creek headsprings, with the specific location to be determined by the authorized officer and the appropriate governmental agencies with land use jurisdiction.

e) If the authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub, determines that monitoring information from the second monitoring well (located near Colton Springs) and all other monitoring information indicate that plant operations may threaten an unacceptable impact to other current beneficial uses of thermal water, or threaten a reduction in the temperature of the A-B or C-D Hot Creek headsprings, one or more mitigation actions, including but not limited to, those listed in paragraphs c(1) and c(2), above, shall be required. In reaching a decision, the authorized officer shall consider, among other factors, the recommendations of the consulting agencies.

f) After monitoring the third monitoring well (located in the area between Colton Springs and Hot Creek headsprings) should the authorized officer determine that plant operations threaten an unacceptable impact or are resulting in an unacceptable impact to beneficial uses of thermal water, or threaten a reduction or are resulting in a reduction in the temperature of the A-B or C-D Hot Creek headsprings, one or more mitigation actions, including, but not limited to, those listed in subparagraphs (a) through (d) below shall be required. In reaching a decision, the authorized officer shall consider, among other factors, the recommendations of the consulting agencies.

(1) Temporarily modify the production or injection of geothermal fluids within the field and monitor the reservoir response. Modification could include one of more of the following:

(i) Change fluid volumes or pressures in one (1) or more wells;

(ii) Discontinue use of one (1) or more production or injection wells; or

(iii) Relocate one (1) or more production or injection wells.

(2) Permanently modify the production/injection program.

(3) Provide an alternative source of thermal water to the affected Hot Creek headspring(s). Such thermal water shall be conveyed to the Hot Creek headspring(s) in a manner that does not facilitate the introduction of other fishes into the headsprings.

(4) Reduce or discontinue power production.

g) If monitoring activities of the three monitoring wells described above indicate a progressive temperature decline is occurring that threatens a change of temperature at the Hot Creek headsprings, A-B or C-D, or threatens the continued existence of the Owens tui chub, the operator shall, at a minimum, implement the mitigation action described in Stipulation f(3) above.

h) The Operator shall be responsible for maintaining the thermal water conveyance facilities described in Stipulation f(3) above for as long as an alternate source of

thermal water is needed to maintain water temperatures in the affected Hot Creek headsprings at levels existing prior to the onset of impacts from plant operations.

i) The Operator shall establish a funding mechanism to ensure that the mitigation actions described in Stipulations (a) through (i) above, will be implemented in a timely manner. Such funding mechanism shall be provided either directly through the provision of materials and services needed to satisfy the monitoring and alternate thermal water supply requirements described above, or indirectly, through insurance, performance bond, dedicating project revenues to a special escrow account or other mechanism acceptable to the Authorized Officer. The funding mechanism shall be developed by the Operator in consultation with the Authorized Officer and the U.S. Fish and Wildlife Service, and agreed to by the Authorized Officer in cooperation with the U.S. Fish and Wildlife Service, prior to the commencement of geothermal production by the Operator.

24. Reclamation:

a) Topsoil from all areas of surface disturbance shall be stockpiled for use in revegetation. The authorized officer may require stabilization of stockpiles using the revegetation plan described below.

b) Reclaim all disturbed areas not required for ongoing activities or operations as soon as practical. Revegetation should be completed by the fifteenth of October of the year the area was disturbed.

c) All disturbed areas shall be recontoured to blend with the surrounding topography. Compacted soils shall be scarified.

d) Spread topsoil evenly over the recontoured area.

e) All areas targeted for revegetation shall be broadcast seeded and mulched with the following seed types and amounts:

Seed type	Amount/acre
Big sagebrush	5 lbs
Antelope bitterbrush	5 lbs
Indian rice grass	10 lbs
Pubescent wheat grass	10 lbs

The revegetated areas shall be fertilized with 16-20-0 ammonium sulfate at the rate of 350 pounds per acre. Seed and fertilizer shall be hand raked into the soil.

Cover the seeded area with brush and rocks or a 2 ton/acre straw mulch.

f) The planting and protection of Jeffrey pine seedlings will be required in locations to be determined by the authorized officer.

g) Revegetation success will be evaluated two years after planting. Replacement plantings or seedings may be required.

h) Irrigation of revegetated areas may be required.

25. An accidential spill containment structure will be constructed at the two culverts near the Highway 203/Hot Springs Road junction. The shutoff gates used to control flow through the culverts will be automatically operated and have a manual override. Design specifications will be submitted for approval via sundry notice or with the utilization permit application (see Appendix A).

26. A quality control officer will be designated by Pacific Energy. This person will have a detailed knowledge of all operational constraints addressed in the plan and all stipulations. This person will be on site during all construction and drilling activities to assure that subcontractors comply with operational constraints. This person will be the primary contact between Pacific Energy and the BLM.

27. A final project reclamation plan shall be submitted to the authorized officer for approval within two (2) years of overall project approval. The reclamation plan will provide details concerning methods and timing of facilities shutdown, removal, and reclamation activities not covered by the reclamation plan included in Stipulation 24 above.

Because these measures have now become part of the project, they are not considered "mitigation measures" in the EIS/SEIR, even though they substantially mitigate the potential environmental impacts of the project. Only those additional measures identified through this analysis are listed in Chapter 4 under "Mitigation." The measures would also apply to the alternative site.

2.1.2 PRODUCTION WELLFIELD AND GATHERING SYSTEM

A total of four production well locations have been identified for the proposed action and are shown on Figure 2-1 as Well Nos. SF 25-32, SF 34-32, SF 35-32, and SF 35A-32. A fifth production well site, SF 45-32, is not currently proposed but would be available as a make-up well or additional production well for the alternative site action (see Section 2.2). Three well sites (SF 25-32 not drilled, SF 35-32 already completed, and SF 45-32 not drilled) were previously proposed in Pacific Energy's Plan of Exploration. The impacts of this plan were analyzed in Environmental Assessment CA-017-86-53, and the plan was approved by the BLM on July 2, 1986. The fluid requirement for the proposed project would be approximately 5,000 gallons per minute (gpm) of 330°F geothermal fluid. The total surface disturbance required to drill the four production well sites is approximately 3.5 acres. Fewer wells may be required depending upon drilling and flow test results.

2.1.2.1 Production Well Drilling and Testing Description

At each approved drilling site, a drill pad approximately 150 feet x 200 feet would be built along with an access road, a 50,000± gallon reserve pit, and on-site sediment collection basins. The reserve pit would be lined with a 40-mil plastic liner and used for the containment and

temporary storage of waste drilling mud and fluids. A typical drilling pad and equipment layout is shown in Figure 2-2. Final equipment placement will depend upon site-specific topographic and environmental considerations and the actual drilling equipment utilized.

A drill rig would then move on-site and commence drilling operations. Production wells are each scheduled to be drilled in about 12 days of drilling time. The drilling rig would also be required to remain on the hole for at least one day for well clean-up and an initial short-term flow testing (approximately two to four hours) into on-site tanks. The drilling rig would be moved from the well site following the short-term flow test.

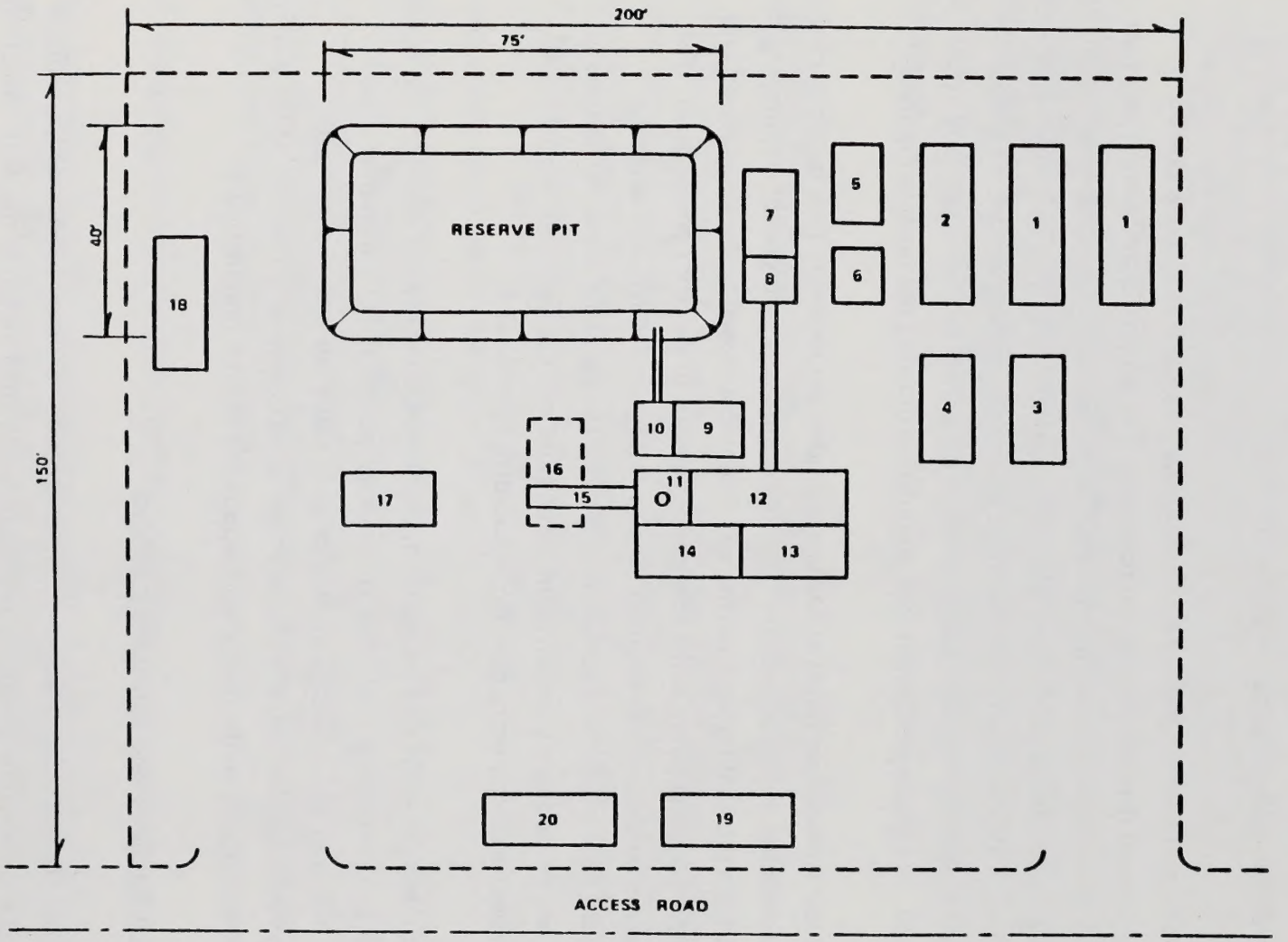
The production wells are each designed to reach a total depth of 700 feet and would be completed in the fractured rhyolite geothermal reservoir. The proposed well casing program consists of 30-inch conductor cemented to 10 feet, 22-inch conductor casing cemented to 80 feet, 16-inch surface casing cemented to 350 feet, and completed with a 13-3/8-inch partially slotted production liner from 350 to 700 feet. All mud used during the drilling of each well would consist of a 8.6 to 9.0 pound-per-gallon weight gel. No hazardous or toxic mud additives are proposed to be used. A typical production well completion drawing is shown in Figure 2-3.

A long-term flow test (two to four days) of each new production well may then be conducted to more accurately determine well productivity. The long-term test would consist of pumping the geothermal fluids from the well through on-site test equipment closed to the atmosphere, and then through a surface booster pump and a temporary pipeline to the MP I power plant. The on-site test equipment would include standard flow metering, recording, and sampling apparatus. Produced fluid would be directed through the existing plant's heat exchangers and injected with the rest of the plant's cooled geothermal fluid into the injection reservoir. All surface test equipment and temporary pipeline would then be removed.

Fewer than five production wells may be required, depending upon drilling and flow test results. If any well drilled as a production well lacks commercial potential, (1) a workover and/or deepening of the well may be conducted in an attempt to make the well commercially productive, (2) the well may be converted to an observation or injection well, or (3) the well may be plugged and abandoned in conformance with applicable federal requirements.

2.1.2.2 Production Wellhead and Downhole Facilities

Each well would be pumped using a deep well, 13-stage, non-toxic, oil-lubricated, centrifugal lineshaft turbine pump driven by a vertical electric motor located on top of the well. An electric



1. Air Compressors
2. Mud Tank
3. Fuel Tank
4. Water Tank
5. Mud Storage
6. Generator
7. Change House
8. Accumulator
9. Mud Pit
10. Shale Shaker
11. Rig Floor
12. Draw Works
13. Storage
14. Dog House
15. Catwalk
16. Pipe Rack
17. Electric Logger
18. Mud Logger
19. Trailer House
20. Trailer Office

FIGURE 2-2
Typical Drilling Pad
and Equipment Layout

SOURCE: Pacific Energy

motor would be mounted on top of the pump discharge head. Wellhead dimensions are not expected to exceed a height of fifteen feet above the ground or four feet in diameter. A small control building (approximately 8 feet x 15 feet) would be located within approximately 50 feet of each well, and would house auxiliary systems, motor switch gear, controls and sensors, and transmitters for key temperature, pressure, and flow rate data. These data would be measured for purposes of process control, continuing resource data acquisition, safety, and environmental protection.

The production of hot geothermal fluid from each lineshaft turbine pump would be flow-rate controlled. Pressure limit sensors would also automatically shut down the pump in the event of an excessively high discharge pressure, which could damage the pump, or an excessively low discharge pressure, which might occur if a pipe ruptured. These and other automatic shutdowns would be equipped, as appropriate, with delays to avoid false shutdowns caused by momentary conditions, and would require overrides during startup.

2.1.2.3 Gathering System

The permanent gathering system for transporting hot geothermal fluid from the wells to the power plant would use insulated pipelines. The pipeline routes are depicted on Figure 2-1. The precise routing could vary slightly depending on final engineering and the design option selected. Pipelines, including insulation, would vary in diameter from 18 to 24 inches depending upon individual well productivities. Horizontal expansion loops (typically a square bend in the pipeline approximately 30 feet x 30 feet) would be constructed every 250 to 350 feet along the pipeline route. An estimated 2,600 feet of production pipeline would be required. The pipe would be buried or located near or below ground level on sleepers and would be colored to blend with the terrain. Selected sections of pipe would be placed below ground level in excavated trenches or buried (see Section 2.1.6.9). Downhole pumps in the production wells would deliver the geothermal fluid to the plant at about 200 pounds per square inch gauge (psig).

2.1.3 POWER PLANT

The proposed power plant would use hot geothermal fluids produced from the geothermal production wells described in Section 2.1.2 to generate electrical power. The power plant facility would be designed to produce a minimum of 10 MWe (net) of electricity. Generated electrical power would be transported from the power plant interconnection facility to SCE's Casa Diablo Substation, located approximately one-quarter mile northwest of the project site. Electrical transmission lines would be mounted along pipelines. The generated power would be

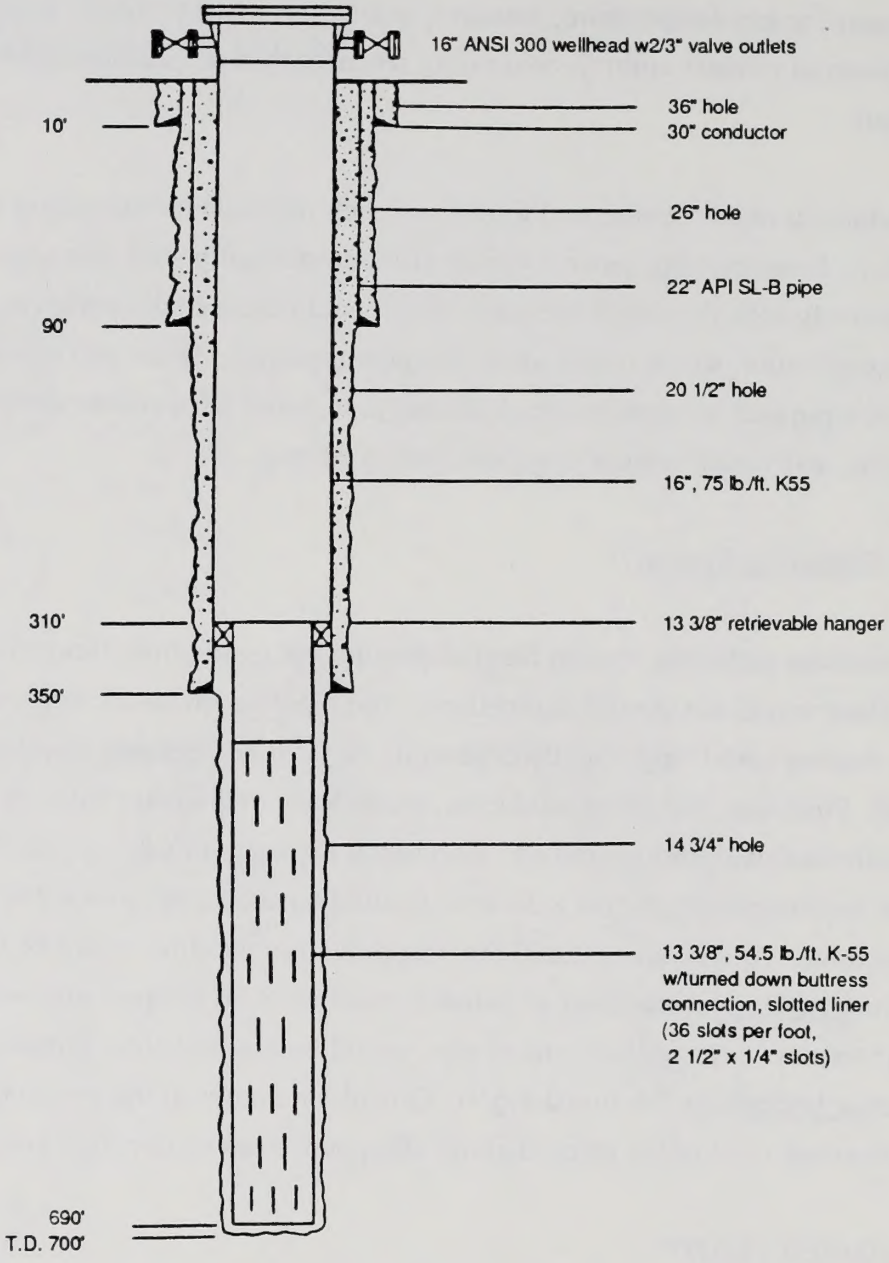


FIGURE 2-3
Typical Production Well
Completion Drawing

SOURCE: Pacific Energy

adjacent to the northwest corner of the project site and following Hot Springs Road to the SCE substation.

The power plant would utilize a closed-system binary process cycle to extract heat from the hot geothermal fluid pumped from the production wells. The geothermal fluid would not be flashed nor exposed to the atmosphere at any time during its utilization. After heat is extracted from the produced geothermal fluid in the facility heat exchangers, the cooled geothermal fluid would be transported from the power plant by a surface pipeline to the injection wellfield facilities (see Section 2.1.4).

The proposed locations of all significant surface development, utilization and injection facilities (collectively termed the project site) are identified in Figure 2-1, including: the production and injection well sites; power plant site; access roads; interconnecting pipelines; electric transmission line; and on-site electrical interconnection facility.

2.1.3.1 Radial Turbo-Expander Generator

Under the proposed engineering design, heat would be extracted from the geothermal fluid in shell-and-tube heat exchangers and transferred to isobutane, the hydrocarbon working fluid. The heated isobutane would be expanded through a turbo-expander generator system, converting the mechanical energy produced to electrical energy. Isobutane vapor from the turbine exhaust would be condensed in air-cooled condensers. The condensed isobutane would then be directed to a storage vessel (accumulator), from which the cooled and condensed isobutane would be pumped to start the closed-system binary cycle again. The principal power generation facilities would be constructed within an area approximately 320 feet wide by 690 feet long, as depicted on the Figure 2-4. The power plant site and adjacent facilities would be protected within a chain-link fence.

The major equipment requirements include shell-and-tube heat exchangers, three turbo-expander generators, air-cooled condensers, isobutane accumulator, isobutane storage vessel, isobutane circulating pump, geothermal fluid injection pump, air compressors, gas freeing compressor, lubricant coolers, firewater tank, utility building, transformers, and electrical switchgear house. Two banks of air-cooled condensers would be used, each approximately 308 feet long by 60 feet wide, with an overall height of approximately 30 feet. The use of air-cooled condensers would eliminate the need for consumptive water use during power plant operation.

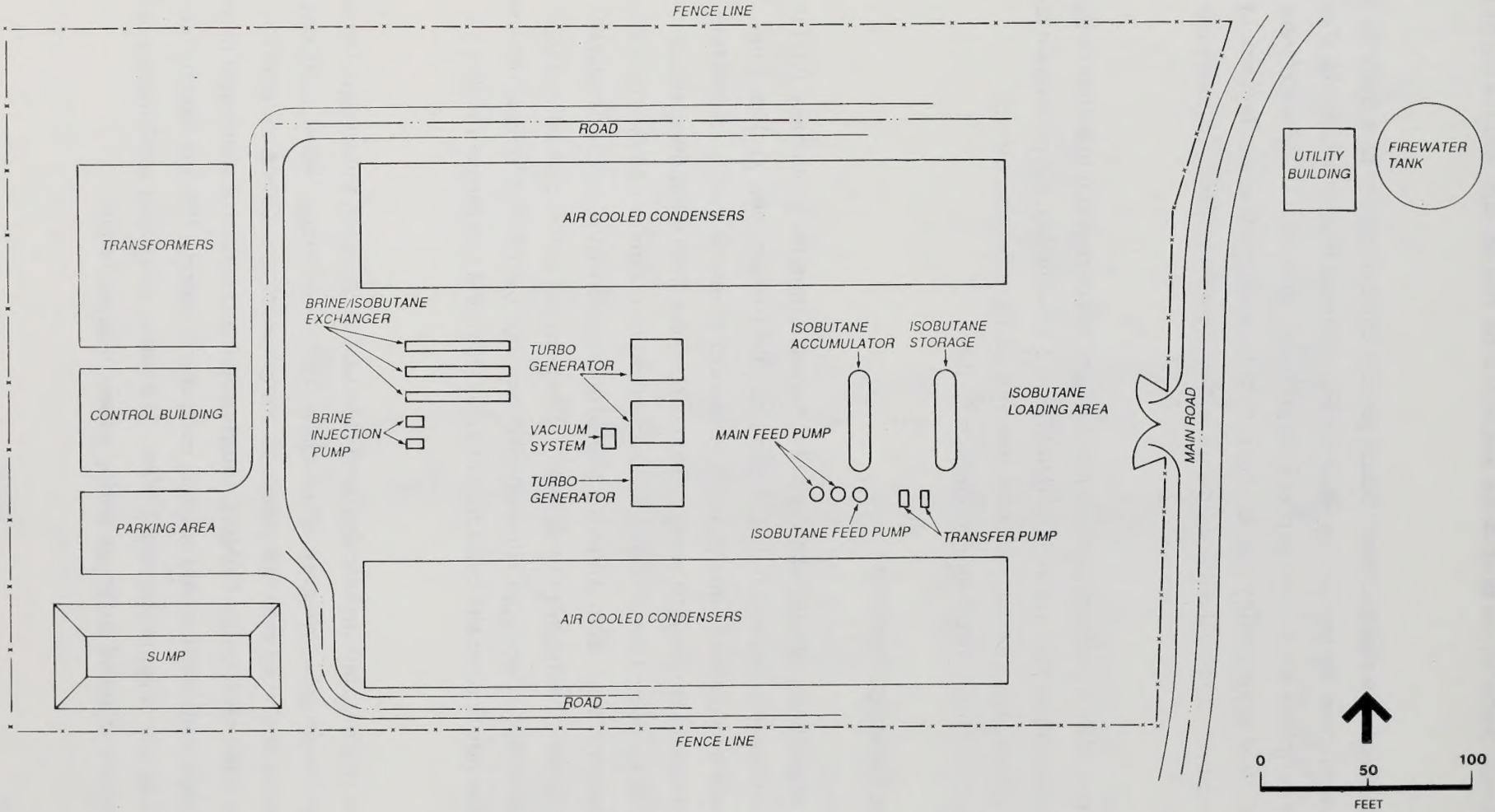


FIGURE 2-4
Power Plant Plot Plan

SOURCE: Pacific Energy

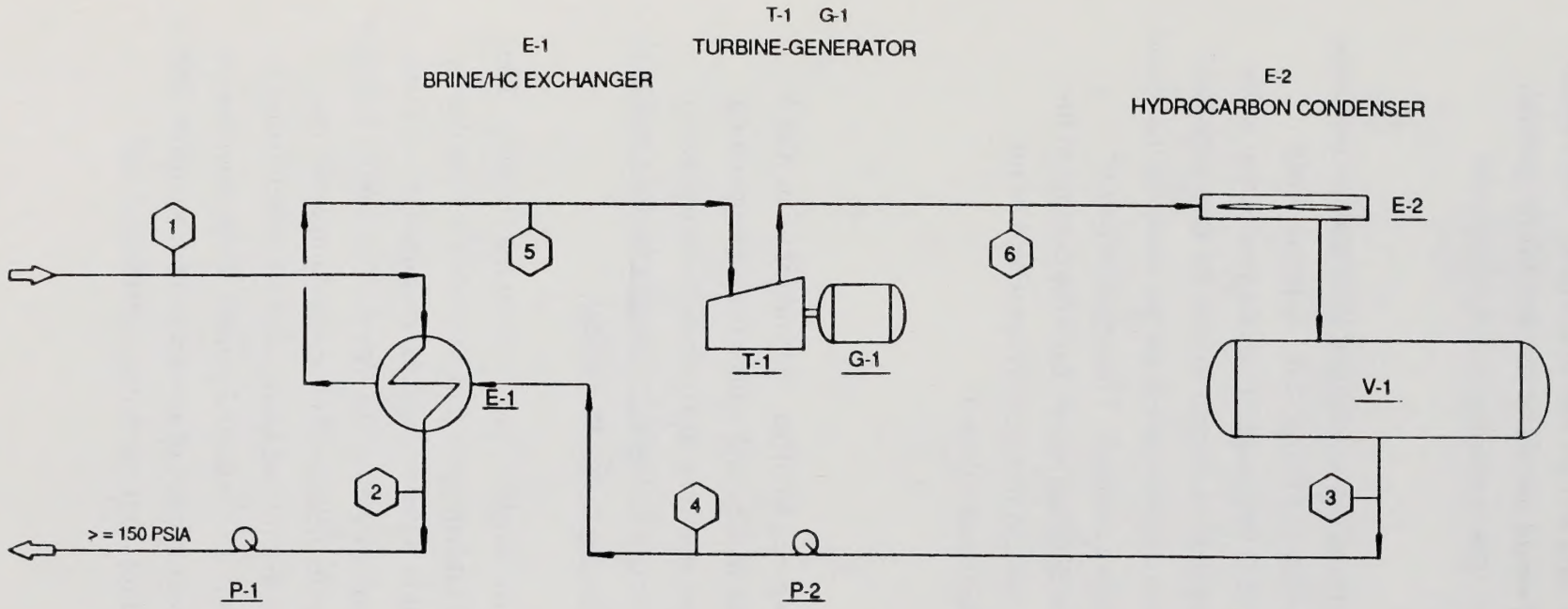
The proposed shell-and-tube heat exchangers would occupy a space approximately 50 feet long by twenty feet wide and twenty feet high. The isobutane accumulator and isobutane storage vessel are cylindrical vessels approximately 70 feet long and ten feet in diameter. The vessels would be placed on supports along their length and would rest about five feet off the ground, reaching a total height of approximately fifteen feet. The remaining major power plant components would not exceed a height of ten feet.

A process flow diagram depicting the mass flows of both the geothermal fluid and the isobutane working fluid through the binary power plant is provided as Figure 2-5. Approximately 5,000 gallons per minute of hot geothermal fluid would be pumped from the production wells through pipelines to the tube side of a shell-and-tube heat exchanger to heat the isobutane fluid. The cooled geothermal fluid would not be exposed to the atmosphere during the cycle but would be pumped directly to the injection wells for subsurface disposal. The apparent loss of geothermal fluid volume indicated on the mass flow diagram results from the cooling of the fluid through the facility and does not result from consumptive use. There would be no difference between the fluid mass produced and fluid mass injected.

2.1.3.2 Additional Power Plant Facilities

One building would be constructed which would serve as an office and control room (O/CR). The O/CR building would house the controls for the facility and offices for plant operating personnel. The O/CR building would be a one-story structure approximately twenty feet in height with an area of from 2,000 to 3,000 square feet. The O/CR building is the only enclosed structure (all other structures at the power plant are open to air circulation).

A potable water and sanitary disposal (septic) system would be provided for the building. The location of the septic system would be determined subsequent to soil suitability testing during final site engineering. As there are no known potable water wells at the proposed power plant site and as the project site is outside of the water service area of the Town of Mammoth Lakes, a water storage tank would be constructed to store water delivered to the site from either the existing MP I groundwater well located on the adjacent private land and/or by re-activating an old Magma water well on the adjoining private land. The expected potable water requirement for the facility, based on an estimated manpower requirement of sixteen people, would be 300 gallons per day. Bottled water would be furnished for drinking during construction and production operations.



STREAM NO.	1	2	3	4	5	6
FLUID	Brine	Brine	HC	HC	HC	HC
FLOW 1000/HR	2,250	2,250	2,040	2,040	2,040	2,040
GPM	5,000	4,600	7,730	7,010	-	-
RCFM	-	-	-	-	4,090	48,000
TEMP (DEG. F)	330	169	114	116	200	166
PRESS. (PSIA)	220	170	87	560	500	92
DENSITY	56.3	60.9	32.7	32.6	6.95	0.05
MMBTU/HR.	665.2	302.0	0	6.0	368.4	325.0

10 MWe Net PLANT

GENERATOR OUTPUT	13,875 KW
PARASITIC LOAD (ONSITES)	2,625
BRINE PUMPING (OFF SITES)	1,250
NET	10,000 KW

FIGURE 2-5
Process Flow Diagram

SOURCE: Pacific Energy

The power plant facility area would be diked with a one- to two-foot berm, or block wall, and drained to a catch basin, located downslope of the facility, of approximately 88,000 gallon capacity. The catch basin is designed for a 20-year storm event and would collect plant runoff and would be available for emergency spill containment. See Section 2.1.5.1 for a description of project-wide emergency spill containment.

All facilities would be constructed to meet or exceed applicable building codes and industry standards.

2.1.4 INJECTION WELLFIELD AND DISTRIBUTION FACILITIES

Based on the three injection wells supporting the existing MPI Project, the proposed project would require four injection wells. The proposed locations for injection wells Nos. SFI 44-32, SFI 54-32, SFI 54A-32 and SFI 64-32, are shown on Figure 2-1. The total surface disturbance required to drill the four injection well sites would be approximately three acres.

2.1.4.1 Injection Well Drilling and Testing Description

At each approved drilling site, a drill pad approximately 150 feet x 200 feet would be built along with access and a 50,000± gallon, plastic-lined reserve pit for the containment and temporary storage of waste drilling mud and fluids and on-site sediment containment basins as discussed for production well sites (see Section 2.1.2.1). A typical drilling pad and equipment layout would also be similar to that discussed earlier for production well drilling (Figure 2-2). Final equipment placement would depend upon site-specific topographic and environmental considerations and the actual drilling equipment utilized.

The injection wells have been designed to reach a maximum depth of 2,000 feet and would be completed in the Bishop Tuff. The proposed well casing program consists of 30-inch conductor cemented to ten feet, 22-inch conductor casing cemented to 120 feet, 13-3/8-inch surface casing cemented to 1,000 feet and completed with 10-3/4-inch slotted liner to 1,000 to 2,000 feet. All mud used during the drilling of each well would consist of a 8.6 to 9.0 pound-per-gallon weight gel. No hazardous or toxic mud additives are proposed to be used.

Following well drilling, the well would be cleaned up in much the same way as described for

production well testing. An initial injectivity test may also be conducted by injecting the geothermal fluid produced during the initial flow test back into the well. A long-term flow test may be conducted to more accurately determine the well's injectivity and/or productivity. This test would be similar to the long-term production well flow test described in Section 2.1.2.1.

Fewer injection wells may be required, depending upon actual drilling and injectivity test results. Expectations are that three injectors may suffice, with the fourth well providing standby capacity. If any well drilled as an injection well lacks commercial injection potential, a workover and/or redrilling of the well may be conducted, the well may be converted to an observation well or the well may be plugged and abandoned in conformance with federal requirements. If any well drilled as an injection well indicates commercial production potential, it could be converted to a production well.

2.1.4.2 Injection Pumps and Gathering System

Residual, cooled geothermal fluid from the plant would be pumped to the injection wells through pipelines having diameters ranging from 18 to 24 inches, including insulated wrapping to meet applicable safety regulations. The injection pump would be an above ground, horizontal, centrifugal pump driven by a variable speed electrical motor. It would be located within the power plant area and would be about five feet high by ten feet long. An estimated total of 1,700 feet of injection pipeline would be required. The pipelines would be either buried or at or near ground level on sleepers or in trenches below grade and would be colored to blend with the terrain. Each well would be monitored as to injection rate, temperature, and pressure in order to aid in process control and resource management.

2.1.5 EMERGENCY RESPONSE AND PREVENTION

Design features as well as plans of action have been developed to deal with spills, well blowouts, fire and the release of hazardous gases. The Emergency Spill Containment Plan and its attachments which describe the plans are summarized in subsequent sections. The entire plan is in Appendix A of this EIS/SEIR Addendum.

2.1.5.1 Spill Prevention and Containment

2.1.5.1.1 Well Drilling, Testing and Construction

During well site construction prior to drilling, each well site would be graded to drain to a lined mud pit. The entire well site would be bermed to contain small spills on-site during drilling and testing operations. Sedimentation basins would also be constructed on each well site to contain site runoff from storm events which may occur during drilling operations. Down gradient sides of cut or fill slopes would be lined with filter fences or hay bales to retard soil erosion and sedimentation should on-site containment fail.

During well drilling operations 10,000 gallons of cold water would be stored on-site to be available to kill the well in the event that well control problems should arise. During power plant operations 50,000 gallons of cold water would be stored within the project area and would be available for well control problems after commercial operations begin.

In addition, the project-wide site spill containment facility described in Section 2.1.5.1.3 would be utilized as a backup containment mechanism to prevent spills from leaving the project site.

2.1.5.1.2 Operations

Wellhead areas would be bermed to prevent minor spills from leaving the site such as could occur during well servicing operations.

Seamless welded pipes would be used along the entire length of production and injection pipeline to minimize the possibility of leaking connections. Isolation valves would be located within the pipelines the prevent backflow of geothermal fluid, should a leak occur. Major pipeline leaks or ruptures would be detected by in-line sensing equipment. A fail-safe mechanism is included that, in the event of an electrical failure, the flow from all wells would automatically be blocked by safety shut-off valves. If pressure suddenly dropped, alarms would sound in the plant, isolation valves in the pipeline would close, and the wells would be shutdown automatically within less than one minute. If all automatic shutdown controls failed, the pumps and isolation valves could be shutdown from the plant control rooms within two to three minutes. Should all electricity fail, pumps would stop and valves would shut automatically. In addition, all pumps and valves could be closed manually by plant personnel within five minutes. The power plant facility would be diked and drained to an on-site catchment basin of approximately 88,000-gallon design capacity. The catchment basin would collect site runoff and

would be available for emergency spill containment. This basin is designed to catch any surface runoff or rainwater up to the volume from a 20-year one-hour design storm event. Rainwater in the catchment basin would be allowed to infiltrate and evaporate.

Under almost all expected atmospheric conditions, isobutane, if spilled, would evaporate before the spill could spread. Any identified potential spill sources in the power plant, such as the isobutane accumulator and switchyard transformers, would be individually curbed to contain spills during operations. In the event that spills were not fully contained by the on-site source specific containment facilities, leakage would flow to the on-site catchment basin and then to the project-wide containment facilities.

2.1.5.1.3 Project-Wide Emergency Spill Containment

Prior to well drilling or power plant construction, emergency spill containment facilities would be constructed down gradient of all proposed PLES Project facilities as shown in Figure 2-1. The emergency spill containment facilities would take advantage of the natural drainage in the project site and would be available to contain spilled substances from anywhere in the project site. The large spill containment basin to the west would serve as the principal emergency spill containment facility for most of the project site and is designed to contain about 1.6 million gallons. The smaller spill containment area to the east provides backup storage capacity of about 92,500 gallons and serves as the principal emergency containment for part of the injection well field.

The spill containment facilities would be constructed by installing vertical sluice gates down gradient of the project site on extensions of two existing culverts which drain the project site. One culvert crosses beneath State Route 203 and the second culvert crosses beneath Hot Springs Road.

The existing culvert pipes under State Route 203 and Hot Springs Road would be extended to approximately 43 feet from the centerline of the existing road where a concrete headwall would be constructed. A vertical lift gate would have an electric valve actuator which would activate a compressed gas (nitrogen) gate closure mechanism for automatic operation. The gate could also be closed by an independent handwheel for manual operation. The valve would be open under normal operating conditions, but closed in the event of a spill from a pipeline or wellsite. The spill would be held in the containment facility, analyzed, and disposed of in a manner approved by the Lahontan Regional Water Quality Control Board.

These containment facilities would be constructed before any new construction or well drilling took place. Each portion of the project site drains to one of the two spill containment areas. Therefore, should any discharges or spills occur during drilling, testing, or servicing activities, the spill containment facilities would be in place to handle them.

During the short term well drilling, testing, and site construction activities prior to commercial production, the sluice gates would be maintained in a closed position except to permit natural drainage from rain, snow melt, or spring flow from the area. The closed sluice gates would thereby provide secondary emergency spill containment prior to installation of an automatic control system for commercial production operations. Operation of sluice gates would be manual during this preliminary phase of development.

During normal commercial production operations the sluice gates would remain open allowing a natural drainage. However, if a major spill should occur the gates would be closed providing secondary containment of any spilled substance in the project area. The gates would automatically close as a result of loss of electrical power or if there were an imbalance between the measured rates of production and injection. The gates could also be actuated to close manually from the control room. The production and injection flow would be continually compared electronically. Under normal circumstances the flows should be equal with minor fluctuations. The Emergency Spill Containment Plan states that should the difference between the production flow and the injection flow be as large as 10% of the total flow (such as would occur if there were a major geothermal fluid leak or pipeline rupture) the sluice gate valve actuators would automatically close, the production pumps and injection pump(s) would stop, and an alarm would sound and be displayed in the control room.

2.1.5.2 Well Blowout Control

Blowout prevention equipment would be kept in operating condition and tested in compliance with BLM regulations and industry standards. During drilling operations, a minimum of 10,000 gallons of cool water and 12,000 pounds of barite would be stored at the well site for use in killing the well in the event of a blowout.

2.1.5.3 Fire Prevention and Control

The power plant equipment containing the isobutane working fluid would be protected from overheating and fire damage by a fire resistant insulation or cement. Such equipment includes the

isobutane accumulator vessel and the heat exchangers. A water system with hydrants and fire hoses would also be installed to assist in fire suppression and in cooling equipment, if necessary. The working air-cooled isobutane condensers would be located on top of a steel supporting structure about twenty feet above grade. The structural steel columns and beams would be fireproofed to resist fire damage for up to two hours. Fire-related equipment would include: (1) a water-storage tank (minimum 220,000-gallons capacity); (2) fire pump and accessories, including: electric fire pump with batteries and charger, diesel fire pump with diesel fuel system, jockey pump controllers, and associated valves, pipes and fittings; (3) fire protection apparatus, including: fire hydrants, monitors, and valves; automatic sprinkler for the control building; fire line pipes and fittings; and (4) fire alarm system, including: control panel and six combustible gas monitors. The monitors sound a "warning" in the control room if the combustible gas concentration at the sensor reaches 30 percent of the lower explosive limit (LEL) and sound an "alarm" if the concentration reaches 60 percent of the LEL.

2.1.6 LANDSCAPE, REVEGETATION, AND CAMOUFLAGE

The Landscape and Revegetation Plan for the proposed action is attached as Appendix B. It includes the elements described in the following sections.

2.1.6.1 Stockpiling of Topsoil

Topsoil would be stockpiled from all graded areas. After disturbed areas have been recontoured, the topsoil and duff would be spread and planting or seeding done. This procedure had been very successful in providing a planting bed for seedlings with a bank of seed from the native vegetation which allows for the rapid re-establishment of native flora.

2.1.6.2 Mulching

Mulching of seeded areas increases germination rates while also decreasing runoff and erosion. All seeded areas would be mulched.

2.1.6.3 Seeding

After the topsoil and duff has been spread over disturbed areas, these areas would be seeded with a mix of grass and shrub seeds as shown in Table 2-2.

TABLE 2-2: SEED MIX/a/

Species	Common Name	Percentage of Mix
Artemisia tridentata	Sagebrush	15%
Purshia tridentata	Bitterbrush	15%
Orysopsis hymenoides 'Nespar'	Indian rice grass	10%
Elymus cinereus	Great basin wild rye	20%
Agropyron desetorum 'Nordan'	Crested wheat grass	20%
Agropyron trichophorum 'Mandan'	Pubescent wheat grass	20%

/a/ No rate of seed application was given in the plan. After seeding, a 20-20-20 fertilizer would be applied at a rate of 350 pounds per acre.

SOURCE: Josephine McProud. 1988. Landscape and Revegetation Master Plan for PLES I Geothermal Plant. Submitted by Pacific Energy as part of the project description.

2.1.6.4 Seedling Planting

In some areas additional planting of shrub seedlings (see Table 2-3) are specified in the Landscape plan. These seedlings would be contract grown from locally collected seed. Percentages and spacings would be designed to match natural plant distribution as closely as possible. Reforestation with pine seedlings would occur in some of the more heavily forested areas.

2.1.6.5 Container-Grown Plants

In some areas, plants larger than seedlings are recommended for visual mitigation. Careful consideration has been given to selecting plants which are native to the Eastern Sierra area. However, since the availability of nursery-grown natives is somewhat limited, a strict adherence to the "natives only" rule seems impossible. Rate of growth, screening properties, and availability were also factors in plant selections. See Table 2-3 for a list of container grown plantings.

2.1.6.6 Tree Spade Transplanting

Trees in excess of 30 feet in height would be transplanted from areas scheduled for occupancy using a large tree spade, to areas around the plant site. Transplanted pines would range in height from eight to 30+ feet and would be guaranteed for a period of one year. Locations have been selected to conceal plant facilities from the immediate view, as well as the distant view.

TABLE 2-3: SEEDLINGS AND CONTAINER-GROWN PLANTINGS

Species	Common Name	Percentage of Mix
Artemisia tridentata	Sagebrush	45%
Purshia tridentata	Bitterbrush	30%
Chrysothamenus nauseosus	Rubber rabbitbrush	15%
Prunus andersonii	Desert peach	10%
Pinus jeffreyii	Jeffrey pine	seedling or container grown as needed for screening and reforestation.
Ribes cereum	squaw current	container-grown
Salix exigua	native willow	container-grown
Rosa woodsi	wood rose	container-grown
Amelanchier almifolia	serviceberry	container-grown
Quercus vaccinifolia	huckleberry oak	container-grown

SOURCE: Josephine McProud. 1988. Landscape and Revegetation Master Plan for PLES I Geothermal Plant. Submitted by Pacific Energy as part of the project description.

2.1.6.7 Irrigation

Irrigation to seeded and planted areas is provided to ensure seed germination and successful establishment of seedlings and container-grown stock. A temporary overhead system would be installed as indicated on the plans. This system would remain in place for at least a two-year period for appropriate establishment of vegetation. A permanent drip irrigation system would be installed to container-grown stock and transplanted specimens. Water usage would be kept to a minimum.

2.1.6.8 Painting

Colors would be selected for painting of pipelines and other structures. These colors would blend with natural occurring tones in each specific area. Camouflage techniques would be used in some areas, and would involve the use of several colors to create a texture or pattern more in keeping with the natural surroundings.

2.1.6.9 Trenching and Retaining Walls

Production and injection pipelines would be buried or placed in trenches is some areas which are especially visually sensitive and for which other techniques for concealing the pipeline are impractical (see Figure 2-1). Erosion control and revegetation is specified on all areas disturbed by trenching. Where the new grade encroaches significantly into the drip line of existing trees, retaining walls would be constructed. These walls would help ensure the survival of many existing trees which would otherwise need to be removed. Ramps would be built across pipelines at the discretion of the authorized officer to facilitate the passage of deer.

2.1.7 HYDROLOGIC MONITORING PLAN

The monitoring plan, shown in Table 2-4, was developed in consultation with the Long Valley Hydrologic Advisory Committee./2/ It is designed to help determine baseline conditions in the hydrologic systems, changes which may occur, and factors which may affect them. It would also provide information which can be used to trigger reservoir management or other mitigation techniques. Pacific Energy has agreed to participate fully in LVHAC and will supply appropriate information. The hydrologic monitoring plan for which Pacific Energy is responsible is shown in Table 2-4.

/2/ The use of water resources, including geothermal resources, in Long Valley Caldera is a major resource management issue in Mono County. There is a consensus that more information about the hydrologic regime would help decision-makers, land managers, and users of the resource to plan for the area. Accordingly, the Long Valley Hydrologic Advisory Committee (LVHAC) has been established under the auspices of Mono County to bring together, in an advisory capacity, representatives of agencies that have hydrology-related permitting authority or operations and parties who have proposed or current activities which would affect hydrologic systems within Long Valley Caldera. The primary activity of LVHAC is to oversee a hydrologic monitoring program. The monitoring program is designed to help determine baseline conditions in the hydrologic systems, changes to the systems, and factors which may affect the systems.

TABLE 2-4: BLM's REQUIRED HYDROLOGIC MONITORING PLAN (developed in coordination with LVHAC)

Sites	Purpose	Type	Frequency
	Fish Hatchery Springs		
AB & CD group springs at Hot Creek Hatchery	Detect changes in flow, temperature, and water chemistry	F,T C/a/, I	C Q
	Hot Creek Gorge Springs		
Hot Creek above swimming area	Upstream site for salinity-gain measurements to calculate flow of thermal springs in gorge	F,C_L,T	M
Hot Creek Flume	Downstream site for salinity-gain measurements	F,C_L,T	M
	Casa Diablo Power Plants		
Colton Spring	Detect changes in spring flow, temperature, and chemistry caused by wells supplying geothermal power plants	F T C/a/, I	C M S
Casa Diablo Spring	Detect changes in spring flow, temperature, and chemistry caused by wells supplying geothermal power plants	F T C/a/, I	C M S
Production and injection wells	Determine reservoir characteristics and changes changes due to production and injection	C, I (for selected wells) Following the drilling of wells, the company will provide pressure and temperature profiles and data from short term flow or injection tests. During production, the company will continuously monitor well discharge and injection rates and downhole production pressure. Well head temperatures and injection pressures are to be taken daily.	S

(cont.)

TABLE 2-4: BLM's REQUIRED HYDROLOGIC MONITORING PLAN (developed in coordination with LVHAC) (Continued)

Sites	Purpose	Type	Frequency
	Casa Diablo Power Plants (cont.)		
Observation Well 65-32	Detect changes in reservoir characteristics due to production and injection	W Tp,C,I	C (1st yr), M (after 1st yr) S
Unnamed stream upstream of culvert under Hot Springs Road east of MPI and upstream of culvert under gas tank road.	Determine stream flow and water quality	S C	Q S

Legend of Abbreviations

Type of Data:

- A atmospheric pressure
- C chemistry-components given in /a/
- C_L limited chemistry (B, Cl, F, Specific conductance, and temperature)
- F flow of springs or streams
- I isotopic analyses (0 18/16, D/H, ^3H)
- P precipitation
- Q quantity of water
- S turbidity and suspended sediment
- T temperature
- T_P temperature profile
- W Water level and/or pressure

Frequency:

- C continuous or at 15 minute intervals
- D daily
- M monthly
- Q quarterly
- S semiannually
- A annually

/a/ pH, alkalinity, chloride, fluoride, nitrite-nitrate, phosphorus, sulfate, ammonia, calcium, magnesium, strontium, sodium, potassium, silica, boron, arsenic, lithium, mercury, iron, manganese, dissolved solids, oxygen isotopes, hydrogen isotopes, tritium.

2.2 ALTERNATIVE LOCATION ACTION

Under the alternative location action, the project would use the same well fields, plant design, and power output. The well fields would remain in the same locations because the resource cannot be moved. The principal difference would be the relocation of the power plant to a location 0.6 miles north of the proposed site, as shown on Figure 2-6. The alternative location is about 150 feet higher in elevation than the proposed power plant site and approximate 3,000 feet from the production and injection fields, it may be necessary to pump approximately 10 to 20% more geothermal fluid (up to a total 6,000 gpm) in order to compensate for temperature losses in the longer gathering lines and to generate more electricity to pump the fluid to and from the well fields. Depending on the production capacity of the wells, it is possible that five production wells would be required. Two to four additional air coolers would be required, resulting in a power plant site 40 to 70 feet longer (about 0.25 acres larger) than the proposed power plant site.

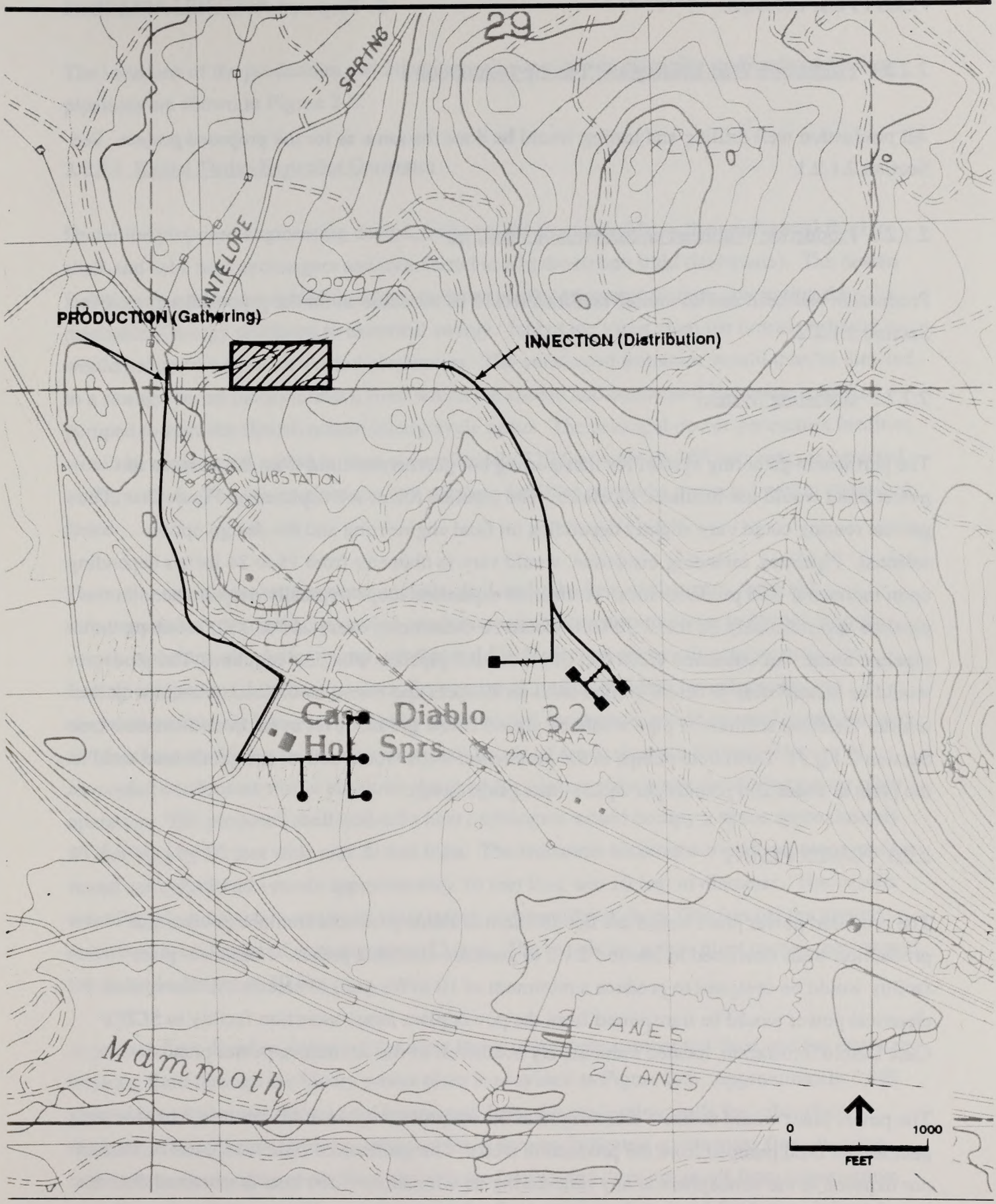
The power plant would have the same east-west orientation as the proposed power plant, but the sump would be located at the lowest elevation on the northwest corner. The gathering pipelines would be about 4,200 feet long and the distribution pipelines, about 4,500 feet long. Their approximate locations are shown in Figure 2-6.

2.2.1 MEASURES INCORPORATED AS A RESULT OF PREVIOUS PROJECT APPROVAL

All mitigations incorporated into the proposed project would be included in this alternative if applicable. Site specific mitigations may be required. See Section 2.1.1.

2.2.2 PRODUCTION WELLFIELD AND GATHERING SYSTEM

A total of four production well locations have been identified for the alternate location action and are shown in Figure 2-1 as Well Nos. SF 25-32, SF 34-32, SF 35-32, and SF 35A-32. A fifth production well site, SF 45-32 would be available as an additional production well if necessary. Three well sites (SF 25-32 not drilled, SF 35-32 already completed, and SF 45-32 not drilled) were previously proposed in Pacific Energy's Plan of Exploration. The impacts of this plan were analyzed in Environmental Assessment CA-017-86-53, and the plan was approved by the BLM on July 2, 1986. The fluid requirement for this alternative would be approximately 6,000 gallons per minute (gpm) of 330°F geothermal fluid. The total surface disturbance required to drill the four production well sites is approximately 3.5 acres. The fifth well would disturb an additional acre.



Alternate Power Plant Site

Production Wells

Injection Wells

SOURCE: Pacific Energy

FIGURE 2-6
Alternate Power Plant Location

2.2.2.1 Production Well Drilling and Testing Description

All production well drilling and testing would be done the same as for the proposed project. See Section 2.1.2.1.

2.2.2.2 Production Wellhead and Downhole Facilities

Production wellhead and downhole facilities would be the same as for the proposed action. See Section 2.1.2.2.

2.2.2.3 Gathering System

The permanent gathering system for transporting hot geothermal fluid from the wells to the power plant would use insulated pipelines. The pipeline routes are depicted on Figure 2-6. The precise routing could vary slightly depending on final engineering and the design option selected. Pipelines, including insulation, would vary in diameter from 18 to 24 inches depending upon individual well productivities. Horizontal expansion loops (typically a square bend in the pipeline approximately 30 feet x 30 feet) would be constructed every 250 to 350 feet along the pipeline route. An estimated 4,200 feet of production pipeline would be required. The pipe would be located near or below ground level on sleepers and would be colored to blend with the terrain. Selected sections of pipe would be placed below ground level in excavated trenches (see Section 2.1.6.9). Downhole pumps in the production wells would deliver the geothermal fluid to the plant at about 200 pounds per square-inch gauge (psig).

2.2.3 POWER PLANT

The proposed power plant would use hot geothermal fluids produced from the geothermal production wells described in Section 2.1.2 to generate electrical power. The power plant facility would be designed to produce a minimum of 10 MWe (net) of electricity. Generated electrical power would be transported from the power plant interconnection facility to SCE's Casa Diablo Substation, located immediately southwest of the alternative power plant site.

The power plant would utilize a closed-system binary process cycle to extract heat from the hot geothermal fluid pumped from the production wells. The geothermal fluid would not be flashed nor exposed to the atmosphere at any time during its utilization. After heat is extracted from the produced geothermal fluid in the facility heat exchangers, the cooled geothermal fluid would be transported from the power plant by a surface pipeline to the injection wellfield facilities (see Section 2.1.4).

The locations of the production and injection well sites, power plant site, and interconnecting pipelines are shown in Figure 2-6.

2.2.3.1 Radial Turbo-Expander Generator

Under the proposed engineering design, heat would be extracted from the geothermal fluid in shell-and-tube heat exchangers and transferred to a hydrocarbon fluid (isobutane). The heated isobutane would be expanded through a turbo-expander generator system, converting the mechanical energy produced to electrical energy. Isobutane vapor from the turbine exhaust would be condensed in air-cooled condensers. The condensed isobutane would then be directed to a storage vessel (accumulator), from which the cooled and condensed isobutane would be pumped to start the closed-system binary cycle again. The principal power generation facilities would be constructed within an area approximately 320 feet wide by 760 feet long, as depicted on Figure 2-6. The power plant site and adjacent facilities would be protected within chain-link fence.

The major equipment requirements include shell-and-tube heat exchangers, three (3) turbo-expander generators, air-cooled condensers, isobutane accumulator, isobutane storage vessel, isobutane circulating pump, geothermal fluid injection pump, air compressors, gas freeing compressor, lubricant coolers, firewater tank, utility building, transformers, and electrical switchgear house. Two banks of air-cooled condensers would be used, approximately 380 feet long by 60 feet wide, with an overall height of approximately 30 feet. The use of air-cooled condensers would eliminate the need for consumptive water use during power plant operation. The proposed shell-and-tube heat exchangers would occupy a space approximately 50 feet long by 20 feet wide and 20 feet high. The isobutane accumulator and isobutane storage vessel are cylindrical vessels approximately 70 feet long and 10 feet in diameter. The vessels would be placed on supports along their length and would rest about five feet off the ground, reaching a total height of approximately 15 feet. The remaining power plant components would not exceed a height of 10 feet.

A process flow diagram depicting the mass flows of both the geothermal fluid and the isobutane working fluid through the binary power plant is provided as Figure 2-5. Approximately 6,000 gpm of hot geothermal fluid would be pumped from the production wells for subsurface disposal. The apparent loss of geothermal fluid volume indicated on the mass flow diagram results from the cooling of the fluid through the facility and does not result from consumptive use. There would be no difference between the fluid mass produced and fluid mass injected.

2.2.3.2 Additional Power Plant Facilities

Additional power plant facilities would be the same as for the proposed project.

2.2.4 INJECTION WELLFIELD AND DISTRIBUTION FACILITIES

The alternative location probably would require four injection wells. The proposed locations for injection wells Nos. SFI-44-32, SFI 54-32, SFI 54A-32 and SFI 64-32 are shown on Figure 2-1. The total surface disturbance required to drill the four injection well sites would be approximately three acres.

2.2.4.1 Injection Well Drilling and Testing Description

Injection well drilling and testing would be the same as for the proposed project. See Section 2.1.4.1.

2.2.4.2 Injection Pumps and Gathering System

Residual, cooled geothermal fluid from the plant would be pumped to the injection wells through pipelines having diameters ranging from 18 to 24 inches, including the insulated wrapping to meet applicable safety regulations. The injection pump would be an above ground, horizontal, centrifugal pump driven by a variable speed electrical motor. It would be located within the power plant area and would be about five feet high by ten feet long. An estimated total of 4,500 feet of injection pipeline would be required. The pipelines would be at or near ground level on sleepers and would be colored to blend with the terrain. Each well would be monitored as to injection rate, temperature and pressure in order to aid in process control and resource management.

2.2.5 EMERGENCY RESPONSE AND PREVENTION

Design features as well as plans of action have been developed to deal with spills, well blowouts, fire and the release of hazardous gases. The Emergency Spill Containment Plan and its attachments which describe the plans are summarized in Section 2.1.5. The entire plan is in Appendix A of this EIS/SEIR.

2.2.6 LANDSCAPE, REVEGETATION, AND CAMOUFLAGE

The Landscape and Revegetation Plan for the alternate location action, attached as Appendix B, would contain the same basic elements as for the proposed project (see Section 2.1.6).

2.2.7 HYDROLOGIC MONITORING PLAN

At a minimum, the hydrologic monitoring plan for the alternative site would be the same as for the proposed project. See Section 2.1.7.

2.3 SMALLER POWER PLANT ALTERNATIVE

The smaller power plant alternative of about seven MWe (net) would be located at the site of the proposed project. It would use the same technology as the proposed project and would have two turbo exchangers and generators, six heat exchangers, and 30 air condensers. The smaller power plant would be about 80 feet shorter in the westerly direction than the proposed project. Three production wells producing 3,800 gpm and three injection wells would be required. The smaller power plant alternative plot plan is shown in Figure 2-7.

2.3.1 MEASURES INCORPORATED AS A RESULT OF PREVIOUS PROJECT APPROVAL

The stipulations would be the same as for the proposed project. See Section 2.1.1.

2.3.2 PRODUCTION WELLFIELD AND GATHERING SYSTEM

A total of three production well locations have been identified for the smaller power plant. They are shown on Figure 2-1 as Well Nos. SF 25-32, SF 34-32, and SF 35-32. Production well sites SF 45-32 and SF 35A-32 are not currently proposed but would be available as make-up wells or additional production wells. Three well sites (SF 25-32 not drilled, SF 35-32 already completed, and SF 45-32 not drilled) were previously proposed in Pacific Energy's Plan of Exploration. The impacts of this plan were analyzed in Environmental Assessment CA-017-86-53, and the plan was approved by the BLM on July 2, 1986. The fluid requirement for this alternative would be approximately 3,800 gpm of 330° geothermal fluid. The total surface disturbance required to drill the three production well sites would be approximately 2.7 acres.

2.3.2.1 Production Well Drilling and Testing Description

Production well drilling and testing would be the same as for the proposed project.

2.3.2.2 Production Wellhead and Downhole Facilities

Production wellhead and downhole facilities would be the same as for the proposed project.

2.3.2.3 Gathering System

The permanent gathering system for transporting hot geothermal fluid from the wells to the power plant would use insulated pipelines. The pipeline routes are depicted on Figure 2-1. The precise routing could vary slightly depending on final engineering and the design option selected. Pipelines, including insulation, would vary in diameter from 18 to 24 inches depending upon individual well productivities. Horizontal expansion loops (typically a square bend in the pipeline approximately 30 feet x 30 feet) would be constructed every 250 to 350 feet along the pipeline route. An estimated 2,400 feet of production pipeline would be required. The pipe would be located near or below ground level on sleepers and would be colored to blend with the terrain. Selected sections of pipe would be placed below ground level in excavated trenches (see Section 2.1.6.9). Downhole pumps in the production wells would deliver the geothermal fluid to the plant at about 200 psig.

2.3.3 POWER PLANT

The proposed power plant would use hot geothermal fluids produced from the geothermal production wells described in Section 2.1.2 to generate electrical power. The power plant facility would be designed to produce a minimum of seven MWe (net) of electricity. Generated electrical power would be transported from the power plant interconnection facility to SCE's Casa Diablo Substation, located approximately one-quarter mile northwest of the power plant site. Electrical transmission lines would be mounted along pipelines. The generate power would be transmitted from the project site to the substation via the existing power line poles located adjacent to the northwest corner of the project site and following Hot Springs Road to the SCE substation.

The power plant would utilize a closed-system binary process cycle to extract heat from the hot geothermal fluid pumped from the production wells. The geothermal fluid would not be flashed

or exposed to the atmosphere at any time during its utilization. After heat is extracted from the produced geothermal fluid in the facility heat exchangers, the cooled geothermal fluid would be transported from the power plant by a surface pipeline to the injection wellfield facilities (see Section 2.1.4).

The proposed locations of all significant surface development, utilization and injection facilities (collectively termed "the project site") are identified in Figure 2-1, including: the production and injection well sites; power plant site; access roads; interconnecting pipelines; electric transmission line; and on-site electrical interconnection facility.

2.3.3.1 Radial Turbo-Expander Generator

Under the proposed engineering design, heat would be extracted from the geothermal fluid in shell-and-tube heat exchangers and transferred to a hydrocarbon fluid (isobutane). The heated isobutane would be expanded through a turbo-expander generator system, converting the mechanical energy produced to electrical energy. Isobutane vapor from the turbine exhaust would be condensed in air-cooled condensers. The condensed isobutane would then be directed to a storage vessel (accumulator), from which the cooled and condensed isobutane would be pumped to start the closed-system binary cycle again. The principal power generation facilities would be constructed within an area approximately 320 feet wide by 610 feet long, as depicted on the Figure 2-7. The power plant site and adjacent facilities would be protected within chain-link fence.

The major equipment requirements include shell-and-tube heat exchangers, two turbo-expander generators, air-cooled condensers, isobutane accumulator, isobutane storage vessel, isobutane circulating pump, geothermal fluid injection pump, air compressors, gas freeing compressor, lubricant coolers, firewater tank, utility building, transformers, and electrical switchgear house. Two banks of air-cooled condensers would be used, approximately 230 feet long by 60 feet wide, with an overall height of approximately 30 feet. The use of air-cooled condensers would eliminate the need for consumptive water use during power plant operation. The proposed shell-and-tube heat exchangers would occupy a space approximately 50 feet long by 20 feet wide and 20 feet high. The isobutane accumulator and isobutane storage vessel are cylindrical vessels approximately 70 feet long and 10 feet in diameter. The vessels would be

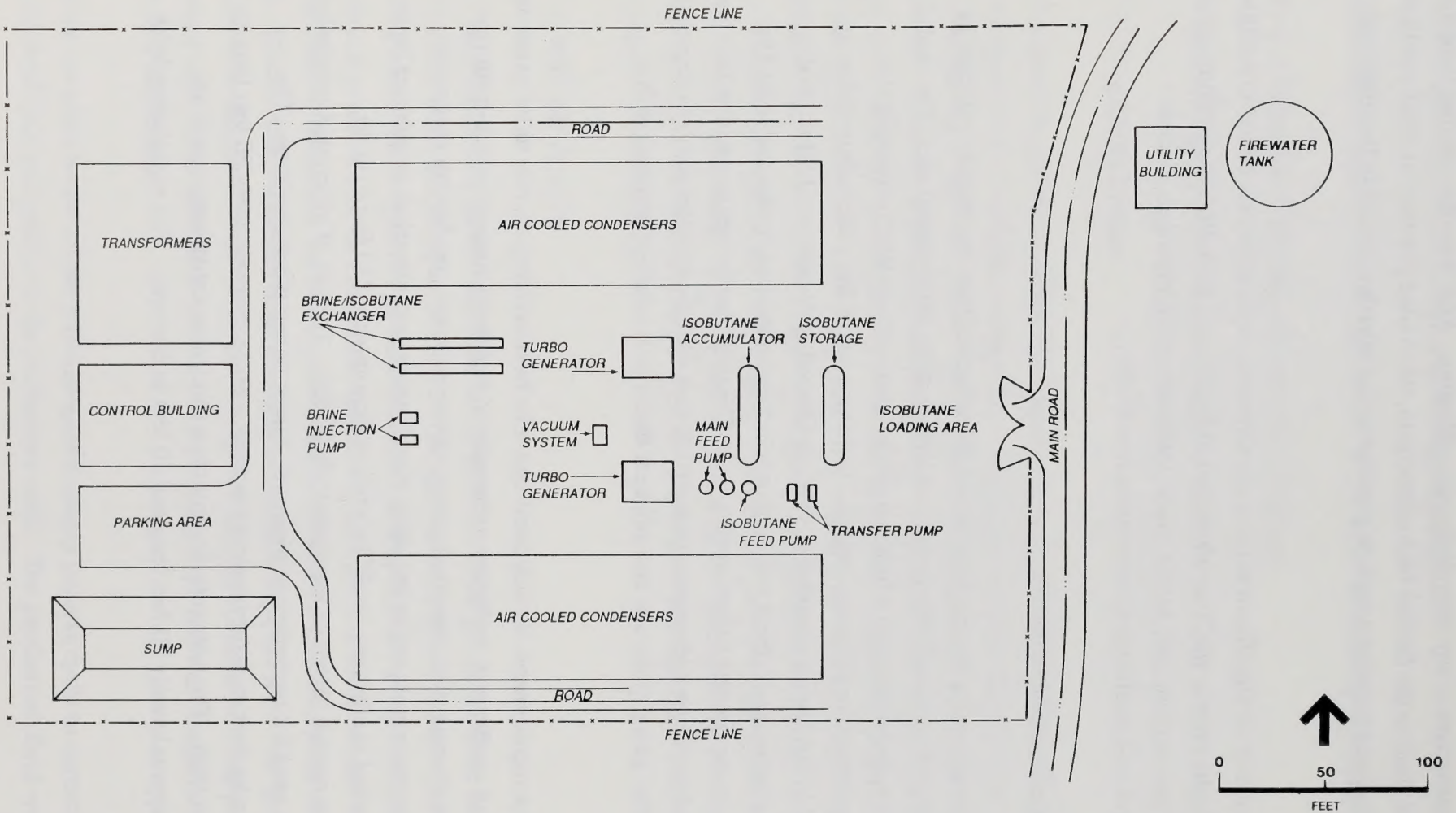


FIGURE 2-7

Smaller Power Plant Alternative Plot Plan

SOURCE: Pacific Energy and ESA

placed on supports along their length and would rest about five feet off the ground, reaching a total height of approximately 15 feet. The remaining power plant components would not exceed a height of 10 feet. A process flow diagram depicting the mass flows of both the geothermal fluid and the isobutane working fluid through the binary power plant is provided as Figure 2-5. Approximately 3,800 gpm of hot geothermal fluid would be pumped from the production wells through pipelines to the tube side of a shell-and-tube heat exchanger to heat the isobutane fluid. The cooled geothermal fluid would not be exposed to the atmosphere during the cycle but would be pumped directly to the injection wells for subsurface disposal. The apparent loss of geothermal fluid volume indicated on the mass flow diagram results from the cooling of the fluid through the facility and does not result from consumptive use. There would be no difference between the fluid mass produced and fluid mass injected.

2.3.3.2 Additional Power Plant Facilities

Additional power plant facilities would be the same as for the proposed project.

2.3.4 INJECTION WELLFIELD AND DISTRIBUTION FACILITIES

Based on the three injection wells supporting the MPI Project, the project would require three injection wells. The proposed locations for injection wells Nos. SFI-44-32, SFI 54-32, and SFI 64-32 are shown on Figure 2-1. The total surface disturbance required to drill the three injection well sites would be approximately three acres.

2.3.4.1 Injection Well Drilling and Testing Description

Injection well drilling and testing would be the same as for the proposed project.

2.3.4.2 Injection Pumps and Gathering System

Residual, cooled geothermal fluid from the plant would be pumped to the injection wells through pipelines having diameters ranging from 18 to 24 inches, including insulated wrapping to meet applicable safety regulations. The injection pump would be an above ground, horizontal, centrifugal pump driven by a variable speed electrical motor. It would be located within the power plant area and would be about five feet high by ten feet long. An estimated total of 1,500 feet of injection pipeline would be required. The pipelines would be at or near ground

level on sleepers and would be colored to blend with the terrain. Each well would be monitored as to injection rate, temperature and pressure in order to aid in process control and resource management.

2.3.5 EMERGENCY RESPONSE AND PREVENTION

Design features as well as plans of action have been developed to deal with spills, well blowouts, fire and the release of hazardous gases. The Emergency Spill Containment Plan and its attachments which describe the plans would be the same as for the proposed project. They are summarized in Section 2.1.5. The entire plan is in Appendix A of this EIS/SEIR.

2.3.6 LANDSCAPE, REVEGETATION, AND CAMOUFLAGE

The Landscape and Revegetation Plan attached as Appendix B, would be the same as for the proposed project. See Section 2.1.6.

2.3.7 HYDROLOGIC MONITORING PLAN

The hydrologic monitoring plan would be the same as for the proposed project. See Section 2.1.7.

2.4 NO-ACTION ALTERNATIVE

Under the no-action alternative, neither proposed well sites nor access roads would be constructed, production and injection well drilling activities would not take place and well testing would not occur, pipelines would not be built, and construction and operation of a 10 MWe (net) binary power plant would not take place as proposed by Pacific Energy.

2.5 SUMMARY OF IMPACTS

The summary of impacts for the four alternatives is in Table 2-5. See Chapter 4 for a complete discussion of impacts.

TABLE 2-5: SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
AIR QUALITY								
Dust Generation	An estimated 16 tons per month of dust would be generated during construction. Project includes soil wetting, placing gravel on unpaved roads, and prompt revegetation and paving or covering of disturbed areas.	Limit speeds on dirt roads to 15 mph.	Estimated 18 tons per month of dust generated during construction. This alternative includes the same measures to reduce impacts as the proposed project.	Same as proposed project	Estimated 14 tons per month of dust generated during construction. This alternative includes the same measures to reduce impacts as the proposed project.	Same as proposed project	No construction would occur.	No mitigation is recommended.
Heavy Equipment Emissions	Diesel exhaust emissions would occur during grading and construction on 13 acres.	No mitigation is recommended.	Diesel exhaust emissions would occur during grading and construction on 15 acres.	No mitigation is recommended.	Diesel exhaust emissions would occur during grading and construction on 12 acres.	No mitigation is recommended.	No construction would occur.	No mitigation is recommended.
Hydrogen Sulfide Emissions	About one kilogram of H2S per hour would be vented to the atmosphere during short-term (2 to 4 hours) well testing and clean out of 8 wells. The project includes an H2S emergency plan.	No mitigation is recommended.	About one kilogram of H2S per hour would be vented to the atmosphere during short-term (2 to 4 hours) well testing and clean out of 9 wells. The project includes an H2S emergency plan.	No mitigation is recommended.	About one kilogram of H2S per hour would be vented to the atmosphere during short-term (2 to 4 hours) well testing and clean out of 6 wells. The project includes an H2S emergency plan.	No mitigation is recommended.	No well drilling would occur.	No mitigation is recommended.
	A spill of the entire production of geothermal fluid would release approximately 0.76 kilograms of H2S.	No mitigation is recommended.	A spill of the entire production of geothermal fluid would release approximately 0.91 kilograms of H2S.	No mitigation is recommended.	A spill of the entire production of geothermal fluid would release approximately 0.58 kilograms of H2S.	No mitigation is recommended.	No geothermal fluid would be used.	No mitigation is recommended.
Hydrocarbon Emissions	Fugitive emissions of isobutane (less than 750 lbs/day) would occur from leaks in the heat exchange system. Project includes leak detection program. The Great Basin Unified Air Pollution Control District would require the use of Best Available Control Technology if it were necessary to meet their permit conditions.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	Fugitive emissions of isobutane (less than 500 lbs/day) would occur from leaks in the heat exchange system; otherwise, this alternative is the same as the proposed project.	No mitigation is recommended.	No additional isobutane would be used or stored in the area.	No mitigation is recommended.
	A catastrophic rupture in the heat exchange system could release 20,000 gallons of vaporized isobutane which could form a flammable vapor cloud. Project includes a leak emergency plan.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	No additional isobutane would be used or stored in the area.	No mitigation is recommended.

TABLE 2-5: SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
GEOLOGY AND SOILS								
Seismicity	Severe groundshaking would occur during a major seismic event.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	No new facilities would be built.	No mitigation is recommended.
			Ground rupture within the plant could cause ruptured geothermal or isobutane lines or collapse of structures.	Perform geophysical studies. Trench along any suspected fault. If found, date fault. Incorporate isolation valves at both ends of surface pipelines whcih cross active faults. Relocate power plant facilities sited on the fault.	Same as proposed project.	Same as proposed project.	No new facilities would be built.	No mitigation is recommended.
Shallow Geothermal Fluids	The likely presence of shallow hot water or steam could damage power plant facilities.	Perform borings to verify current water levels. If necessary, change grading plans or relocate power plant.	If shallow or surficial warm water exists, there could be hazards.	Perform borings to verify current water levels. If necessary, change grading plans.	Same as proposed project, except that smaller power plant could be moved west up to 80 feet and remain on the designated power plant site.	Same as the proposed project.	No new facilities would be built.	No mitigation is recommended.
Volcanism	If a major volcanic eruption occured, a catastrophic spill of geothermal fluids and/or isobutane could occur.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	Same as proposed project.	No mitigation is recommended.	No new facilities would be built.	No mitigation is recommended.
Subsidence	Surface subsidence could result from long-term geothermal production. Project includes construction of subsidence monuments to detect significant surface deformation.	No mitigation is recommended.	Surface subsidence could result from long-term geothermal production. These impacts would be greater than for the proposed project since 20% more fluid would be produced. Project includes construction of subsidence monuments to detect significant surface deformation.	No mitigation is recommended.	Surface subsidence could result from long-term geothermal production. These impacts would be less than proposed project because less fluid would be pumped. Project includes construction of subsidence monuments to detect significant surface deformation.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.
Erosion	Construction would disturb 13 acres. Erosion control measures are included in the project and required by the BLM and Lahontan Regional Water Quality Control Board. Runoff could be captured in the emergency spill containment basins to allow settling of sediments before flow reaches Mammoth Creek.	No mitigation is recommended.	Construction would disturb 15 acres. Erosion control measures are included in the project and required by the BLM and Lahontan Regional Water Quality Control Board. Erosion would affect a larger area and could impact the ephemeral lakes northwest of the alternative power plant site.	Construct berms to direct runoff leaving the power plant site so it would flow away from the ephemeral lakes.	Construction would disturb 12 acres; otherwise, this alternative is the same as the proposed project.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.

TABLE 2-5: SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
Erosion (continued)	Closing the sluice gates on the emergency spill containment basins during construction could allow unnecessary accumulations of water resulting in damage to vegetation and "bathtub" lines if intermittent stream were flowing.	If the intermittent stream is flowing during construction, leave the sluice gates open unless there were an emergency which would call for its use.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	No emergency spill containment basins would be constructed.	No mitigation is recommended.
NOISE								
Construction Noise	Heavy equipment and traffic to and from the site would generate noise, but it would not be audible at the nearest sensitive receptors. Peoples and wildlife nearby would be temporarily affected.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No construction would occur.	No mitigation is recommended.
Operational Noise	The power plant would operate 7 days a week, 24 hours a day. The combined effect of the noise from MP I and PLES I would be about 3 decibels louder than MP I alone. Noise muffling devices are included the design. According to GRO Order No. 4, noise levels would not exceed 65dBA at the lease boundary or 0.5 mile, whichever is further.	No mitigation is recommended.	Noise generted at the alternate power plant site would not blend with noise from MP I because of the distance between the two power plants. A larger area would be impacted.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Noise levels would remain the same.	No mitigation is recommended.
WATER QUALITY AND HYDROLOGY								
Surface Water	Spills of geothermal fluid would be almost certainly contained in bermed areas or in the emergency spill containment basins. In the unlikely event that the roadbed at Route 203 failed and fluid reached Mammoth Creek, under extreme conditions of low stream flow and high ambient temperature, the temperature of the mixed water at the point of entry to Mammoth Creek could reach 118%F . This would cause mortality of fish and other aquatic organisms. Degradation of water quality would occur and could also harm aquatic organisms. The operator would stock the affected reach of Mammoth Creek.	A bioassay would be required in the Plan for Baseline Data Collection.	Same as the proposed project. The greater quantity of fluid required to operate at the alternative location be compensated for by the cooling and infiltration which would occur as the water flowed toward Mammoth Creek.	Same as the proposed project.	Impacts would be like those of the proposed project, except that due to the smaller volume of fluid pumped, the the mixed temperture in the extreme-case spill would be 100 F.	Same as the proposed project.	Spills from MP I which overflowed the bermed areas would flow to Mammoth Creek.	No mitigation is recommended.
Shallow Fresh Groundwater	Vegetation could be impacted if water is used for irrigation and sanitary uses.	Reduce groundwater pumping.	Slightly more groundwater would be used for irrigation of more landscaping and revegetation.	Same as proposed project.	Slightly less groundwater would be used than for the proposed project because of the smaller area	Same as proposed project.	Groundwater consumption would not increase at Casa Diablo.	No mitigation is recommended.

TABLE 2-5: SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
WATER QUALITY AND HYDROLOGY (continued)								
Hydrothermal Resources	Simulated reservoir performance calculations using three different methods predict minor changes to reservoir pressure and temperature due to project operation. The project includes a comprehensive monitoring/mitigation program. One monitoring well has been drilled. The well would be monitored for baseline data. Potential migrations include a variety of reservoir management techniques which would first be triggered by observations in production and injection wells. Subsequent actions would occur, including the drilling of another monitoring well, based on analysis of monitoring results from a variety of natural features and wells. Ultimately, reduction or cessation of power production could be required to protect sensitive hydrothermal resources. If temperatures in Hot Creek headsprings change enough to deviate from their normal ranges, the operator would supply water from another source to allow continued operation of Hot Creek Hatchery and maintenance of the Owens tui chub habitat.	Change some trigger mechanisms (see Section 4.1.4.3.1 in the body of the EIS/ Supplemental EIR. Install a monitoring well near existing monitoring well SF 65-32 which would penetrate the injection reservoir. Before commercial power plant operation begins, require that a detailed program for timely implementation of remedial action measures to supply water to Hot Creek headsprings be approved by the authorized officer.	Same as proposed project, except that up to 20% more geothermal fluid would be pumped for the alternative location.	Same as proposed project.	Same as proposed project, except that 24% less geothermal fluid would be pumped for the smaller power plant alternative.	Same as proposed project.	PLES I could not impact hydrothermal resources.	No mitigation is recommended.
	If, contrary to all reasonable expectations, flow at Hot Creek Gorge fumaroles and springs were diminished by project operations, it would have less value as a geologic interpretive site.	Inject geothermal water upgradient of Hot Creek Gorge to restore flows.	Same as proposed project, except that up to 20% more geothermal fluid would be pumped for the alternative location.	Same as proposed project.	Same as proposed project, except that 24% less geothermal fluid would would be pumped for the smaller power plant alternative.	Same as proposed project.	PLES I could not impact hydrothermal resources.	No mitigation is recommended.

TABLE 2-5: SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
BIOLOGICAL ENVIRONMENT								
Vegetation	Approximately 13 acres of sagebrush scrub and Jeffrey pine plant communities would be lost. The project includes vegetation protection meassures and extensive revegetation.	No mitigation is recommended.	Approximately 15 acres of sagebrush scrub and Jeffrey pine plant communities would be lost. Rhyolite buckwheat scrub would be disturbed by pipelines. Otherwise, this alternative would be the same as the proposed project.	Relocate injection pipelines to avoid rhyolite buckwheat scrub.	Approximately 12 acres of sagebrush scrub and Jeffrey pine plant communities would be lost. The project includes vegetation protection measures and extensive revegetation.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.
Terrestrial Wildlife	The habitat which would be lost is common in the region. No impacts to sage grouse, pygmy nuthatch, bald eagle, peregrine falcon, northern goshawk, Williamson's sapsucker, yellow warbler, hairy woodpecker, or special status animal species would occur.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.
	Noise may affect wildlife around the power plant, but no clear impacts can be defined.	No mitigation is recommended.	If noise impacts wildlife populations. the affect would occur over a larger area if the alternative power plant site were used.	Locate the power plant at the proposed site.	Same as for the proposed project.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.
Mule Deer	Approximately 70 deer were found to use the project area during the spring 1987 migration. They could be affected by pipelines, fencing, and the power plant. Does carrying fawns may be more vulnerable. The proposed project includes below-grade pipeline installation were appropriate. All fencing would be approved by the BLM.	New projects could contribute to off-site mitigation measures in proportion to their impacts.	Impacts to deer would be more severe for this alternative because a larger area would be disrupted and the pipelines would be longer.	Locate the power plant at the proposed site and contribute to off-site mitigation.	Same as for the proposed project.	No mitigation is recommended.	There would be no project impacts.	No mitigation is recommended.
Aquatic Resources	Impacts to aquatic resources are highly unlikely, as described in the hydrology summary. See that section for a discussion of impacts to water quality. The Lahontan Regional Water Quality Control Board has a variety of requirements to protect water quality. Fish would be restocked if mortality resulted from project activities.	A bioassay would be required in the Plan for Baseline Data Collection.	Same as for the proposed project.	Same as for the proposed project.	Same as for the proposed project.	Same as proposed project.	There would be no project impacts.	No mitigation is recommended.
Owens Tui Chub	The Owens tui chub, found in some of the Hot Creek headsprings, would be protected under the progressive monitoring/mitigation program described under hydrology.	See mitigations listed under hydrology.	Same as for the proposed project.	Same as for the proposed project.	Same as for the proposed project.	Same as proposed project.	There would be no project impacts.	No mitigation is recommended.

TABLE 2-5: SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
SOCIAL ENVIRONMENT								
Cultural Resources	Construction and operations personnel could collect or disturb cultural artifacts.	Educate project personnel to the need to leave cultural remains undisturbed.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
	The injection pipeline would pass immediately adjacent to Cultural Resource Sites-7, -8, and -9. Careless use of equipment could damage the sites during laying of the line.	Flag the designated route before work begins and avoid during construction.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
	Subsurface resources may be encountered during construction. If such artifacts are found, construction would stop until suitable actions, approved by the Inyo Forest Supervisor, were taken.	No mitigation is recommended.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
Native American Values	Traditional Native American interests often include areas around hot springs and fumaroles for their special soils and plants and for the springs themselves. Although no specific sites in the project area have been identified as sacred, Pacific Energy has indicated that continued access would be provided.	No mitigation is recommended.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
Range	Approximately two AUMs would be lost to the permittee.	No mitigation is recommended.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
Recreational Resources	In the highly unlikely event that the geothermal features at Hot Creek Gorge were reduced or depleted, a feature which accounts for 95,000 visitor days per year would be lost.	Inject geothermal water upgradient of Hot Creek Gorge to restore flows.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.
	The trout-stocking program would be adversely affected if the hatchery could not function year-round.	See the discussion in the hydrology section.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	There would be no project impacts.	No mitigation is recommended.

TABLE 2-5: SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
SOCIAL ENVIRONMENT (continued)								
Timber	Up to 40,000 board-feet of timber would be harvested. The site is not managed for timber production and is not included in the Inyo National Forest timber base.	No mitigation is recommended.	Up to 220,000 board-feet of timber would be harvested. Otherwise, impacts would be the same as for the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No timber would be harvested.	No mitigation is recommended.
Transportation and Access	Traffic impacts would be minor. If peak project traffic occurred during winter weekend traffic periods, project traffic would be routed to Hot Springs Road at Sherwin Creek Road, if necessary, thereby avoiding the busier Route 203 offramp from Highway 395.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No project impacts would occur.	No mitigation is recommended.
	Unpaved existing roads on the project site would be used for access.	No mitigation is recommended.	The power plant site would be reached by the unpaved dirt road leading to the SCE substation.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No project impacts would occur.	No mitigation is recommended.
Visual Resources	Drilling rigs would be visually strong but temporary elements. After wells were completed, they would be screened by vegetation.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No project impacts would occur.	No mitigation is recommended.
	The power plant would be the most visible element of the project, visible from Route 203 and northbound Highway 395. Existing and transplanted trees would mostly screen the power plant from view, but there would be narrow corridors through which the full 30-foot height of the condensers could be seen. The extensive landscaping, revegetation, and camouflage proposed as part of the project would reduce impacts. There would be no overhead electrical transmission lines. Exterior surfaces would be non-reflective to the extent feasible, exterior night lighting would be minimized, and natural terrain and vegetation would be used to provide visual screening.	No mitigation is recommended.	The power plant would not be visible from Route 203 or Highway 395. It could be seen from Antelope Springs Road, an unpaved road serving dispersed recreation in Little Antelope Valley.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Lanscaping of the area east of MP I where pipelines cross Hot Springs Road would not be done.	No mitigation is recommended.

TABLE 2-5: SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
SOCIAL ENVIRONMENT (continued)								
Community Services	The number of students would increase slightly	The school district may assess fees on commercial development.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	No project impacts would occur.	No mitigation is recommended.
	No significant demands on law enforcement are expected.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	No project impacts would occur.	No mitigation is recommended.
	Health care facilities would be adequate to treat all injuries excetp for severe burns or scalds. Local facilities are not equipped to handle such cases and they would be evacuated.	Revise local emergy response plans to include geothermal accidents. Train on-site personnel in CPR. Develop evacuation procedures for burn victims.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Similar burn accidents could occur at the MP I plant.	Same as the proposed project.
	The proposed project has a fire prevention and protection plan approved by the Long Valley Fire Protection District.	No mitigation is recommended.	Same as the proposed project.	No mitigation is recommended.	Same as the proposed project.	Same as the proposed project.	No project impacts would occur.	No mitigation is recommended.
Street and Road Maintenance	Construction traffic may result in the need for additional maintenance or repair on county and Forest Service roads.	Transfer the cost of repairing damage caused by project activities to the operator. A performance bond could be posted or user fees assessed.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	No project impacts would occur.	No mitigation is recommended.
Wastewater, Soilid Waste, and Utilities	About 300 gallons per day of wastewater would be generated. Solid waste would be taken to the Benton Crossing landfill. Electricity would be bought from SCE if needed.	No mitigation is recommended.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	No project impacts would occur.	No mitigation is recommended.
Hazardous Materials	Some hazardous materials such as diesel fuel, paints, or solvents would be used and stored on the project site. Regional Water Quality Control Board requirement would be followed where applicable.	Follow proper procedures for use, storage, and disposal of all potentially hazardous materials.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	Same as the proposed project.	No project impacts would occur.	No mitigation is recommended.
Geothermal Resource Lease	The proposed project would result in the beneficial use of the geothermal resources within the federal geothermal lease.	No mitigation is recommended.	Same as the proposed project.	Same as the proposed project.	The reduction in output to 7 MWe would constitute a breach of the existing power agreement between the applicant and SCE and could result in termination of the project.	Approve the proposed project.	This alternative would prohibit development of the geothermal lease as currently proposed and could result in forfeiture of the lease.	Approve the proposed project.

TABLE 2-5: SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR ALL ALTERNATIVES (Continued)

RESOURCE	PROPOSED PROJECT		ALTERNATE LOCATION		SMALLER POWER PLANT ALTERNATIVE		NO-ACTION ALTERNATIVE	
	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
SOCIAL ENVIRONMENT (continued)								
Land Use and Planning	The proposed project would change the partially undeveloped character of the site to one of light industrial activity. The project is compatible with Forest Service plans and would not conflict with existing or planned uses in the area.	No mitigation is recommended.	Same as for the proposed project.	No mitigation is recommended.	Same as for the proposed project.	No mitigation is recommended.	No land use changes would occur.	No mitigation is recommended.
Employment, Population, and Housing	An average of 48 workers would be employed over the 9-month construction period, peaking with 82 workers in the fifth month. 16 full-time employees would operate the facility when commercial production begins. Outside workers could cause an increased demand for housing at the lower end of the price scale, potentially increasing housing prices.	Time construction to avoid having the peak construction housing needs coincide with the peak winter housing demand.	Same as for the proposed project.	Same as for the proposed project.	Same as for the proposed project.	Same as for the proposed project.	No project impacts would occur.	No mitigation is recommended.
Economics	The local economy would benefit from the payroll paid to workers, which would be similar to the MP I payroll ($451,000 in 1986), and from plant purchases. The year-round operation of the plant would help stabilize the highly seasonal nature of employment and retail sales.	No mitigation is recommended.	Same as for the proposed project.	No mitigation is recommended.	Same as for the proposed project.	No mitigation is recommended.	The community would forego the economic benefits of the project.	No mitigation is recommended.
	In the highly unlikely event that water temperature changes at Hot Creek Hatchery prevented year-round operation, the hatchery would lose eggs worth up to $16,000 annually at current market rates. In addition, a major portion of the facilities for backcountry aerial planting would have to be moved to other hatcheries. The power plant operator is obligated to supply water to the hatchery so that normal operations can be maintained.	See mitigations described in the hydrology section.	Same as for the proposed project.	No mitigation is recommended.	Same as for the proposed project.	Same as for the proposed project.	No project impacts would occur.	No mitigation is recommended.
	County revenues would increase by about $250,000 per year from property taxes, sales taxes, and a portion of the geothermal lease.	No mitigation is recommended.	Same as for the proposed project.	No mitigation is recommended.	Lower revenues would be generated by the proposed project.	No mitigation is recommended.	The community would forego the economic benefits of the project.	No mitigation is recommended.

3.0 AFFECTED ENVIRONMENT

This analysis of existing conditions is based on the Affected Environment chapter from the earlier EA, but there have been a number of changes. The descriptions have been broadened to include the area of the alternate power plant site. In response to public concern, more information has been included in the biology, hydrology, and cultural resources sections. Additional information from an air quality study done by Great Basin Unified Air Pollution Control District, from a rare plant survey in the Casa Diablo area, and from a geotechnical report on geologic hazards at the proposed power plant site have also been incorporated into this EIS/SEIR. Finally, improvements in equipment operations at the MP I power plant have reduced noise levels and decreased isobutane emissions and these changes are reflected in the appropriate descriptions.

3.1. PHYSICAL ENVIRONMENT

3.1.1 AIR QUALITY

3.1.1.1 Climatological and Meteorological Setting

The following discussion of existing meteorology in the area largely summarizes findings from a meteorological and air quality assessment report prepared for the Mammoth Lakes-Long Valley Caldera area (Tesche, T.W., 1985).

The climate in the eastern Sierra region is predominantly influenced by the large-scale anticyclone centered off the west coast and known as the Pacific High. This semipermanent Pacific high-pressure system moves south in the winter and north in the summer. The Pacific High typically directs storms northward into Oregon and Washington in the summer creating a warm dry climate in the region. In the winter, the high-pressure cell moves south allowing the westerly storm front to bring precipitation, rain and snowfall, to the region.

Frontal activity generally begins in October with intermittent activity for about four to five months, and about 20 to 30 frontal systems pass through the air basin each winter.

Spring is less subject to cloudiness or precipitation but is typically the windiest season of the year. Summers are typically warm and dry with clear skies; however, heavy thundershower activity can occur. Fall has low seasonal precipitation and is usually a transition period between the summer thundershower activity and the winter frontal activity. Annual precipitation within the region varies widely, in part, because of the rain shadow effects of the Sierra Nevada Mountains and ranges from an annual average of 9.87 inches at Lake Crowley (elevation about 6,800 feet) to 29.46 inches at Lake Mary (elevation about 8,900 feet).

Regional summer daytime temperatures range from 65°F to 90°F, and nighttime temperatures range from 37°F to 55°F (WESTEC Services, Inc., 1986). The mean minimum and maximum temperatures for the winter months, December through February, are approximately 27°F and 31°F, respectively, at the Mammoth Ranger Station (Tesche, T.W., 1985).

Typical wind flow is from the west or northwest, but wind direction is strongly influenced by local topography. Wind patterns in the summer are typically orographic influenced systems with daytime upslope (valley winds) and nighttime downslope winds. In the winter, cyclonic storms typically generate wind speeds ranging from 10 to 20 mph; however, winds venting through the Mammoth Summit pass can gust from 50 to 70 mph with occasionally more severe gusts. Santa Ana winds can occur at any time of the year bringing warm dry easterly winds to the area (WESTEC Services, Inc., 1986).

Temperature inversions are meteorologically important with respect to air quality because they inhibit the vertical dispersal of pollutants. A temperature inversion occurs when cool air underlies warmer air. Two basic types of inversion systems occur within Long Valley: radiation and subsidence inversions. Radiation inversions occur on clear cold nights, typical of winter conditions, and are of short duration; while, subsidence inversions are associated with large scale compressional heating of the air column and may last for extended periods.

Climatological information on the structure of temperature inversions in the Mammoth Lakes region is sparse. Generic study results suggest that the average morning mixing heights range from 350 meters in fall to 650 meters in spring. Afternoon mixing heights range from 2,800 meters in summer to about 1,100 meters in winter.

The Great Basin Unified Air Pollution Control District has constructed a meteorological station within the project area on existing well site SF 35-32. Continuous meteorological data

collection, including: ambient air temperature, wind speed, and wind direction, began in January of 1987. A similar meteorologic data collection activity was initiated by the Great Basin Unified Air Pollution Control District at the old Mammoth school, approximately 2.5 miles east of the project site.

3.1.1.2 Air Quality Setting

Although limited air quality monitoring information for the region is available, the Great Basin Unified Air Pollution Control District has monitored the Mammoth Lakes area since 1979 for four criteria pollutants (those for which federal ambient air quality standards have been established), including: total suspended particulates, particulate matter smaller than 10 microns in diameter (PM_{10}), carbon monoxide, and ozone. Other pollutants have been monitored intermittently by either the Great Basin Unified Air Pollution Control District or the California Air Resources Board. Air quality within the Mammoth Lakes/Long Valley area can generally be characterized as good during the summer months; however, during winter months federal and/or state air quality standards for ozone, nitrogen oxides, carbon monoxide and particulate matter have occasionally been exceeded (California State Air Resources Board, 1986).

Mono County is currently "unclassified" for most criteria air pollutants; however, it was recently designated a nonattainment area for particulate pollutants (PM_{10}) (Cox, W.G., 1987a). This, in large part, is attributable to limited air circulation during winter radiation inversion periods and the heavy use of wood burning stoves.

The Great Basin Unified Air Pollution Control District monitored PM_{10} and H_2S levels from January 1987 through December 1987 at a monitoring station approximately one mile east of the proposed project site, near the intersection of Hot Springs Road (old Highway 395) and Sherwin Creek Road (Great Basin Unified Air Pollution Control District, 1988). The purpose of the monitoring was to determine baseline concentrations upon which to evaluate the air quality effects of full-cycle geothermal resource development on the populated areas within Long Valley. The baseline concentrations of these pollutants were found to be well below the applicable ambient standards. For the PM_{10}, the maximum 24-hour average level was 20 micrograms per cubic meter (ug/m^3), and the annual arithmetic mean was 12 ug/m^3, compared to the state standards of 50 ug/m^3 and 30 ug/m^3, respectively. The maximum one-hour average H_2S level was 0.01 ppm, one-third of the ambient standard of 0.03 ppm.

The H_2S levels that were monitored primarily reflect the H_2S emitted by natural vents and hot springs.

3.1.1.2.1 Hydrogen Sulfide

H_2S is a colorless gas often associated with geothermal systems. It is malodorous at relatively low concentrations and can be detected by some persons at concentrations as low as 0.025 ppm. At higher concentrations (50 to 450 ppm) the gas causes throat and eye irritation, and at very high concentrations (greater than 500 ppm) H_2S can result in respiratory paralysis and death. The maximum allowable concentration for an eight-hour occupational work exposure is 20 ppm without protective breathing equipment (8 CAC 5155). There is no federal ambient air standard for H_2S.

Geothermal fluids typically contain naturally occurring gases (noncondensable gases), predominantly carbon dioxide, which may escape from the fluid when it is exposed to the atmosphere. Some of these gases, in particular H_2S, are considered air pollutants. Noncondensable gases contained within geothermal fluids produced from the existing project production well SF 35-32 are typical of those found near Casa Diablo Hot Springs and are identified in Table 3-1.

The state one-hour ambient air standard for H_2S (0.03 ppm) was equalled on two occasions during a one-year monitoring period conducted within the Long Valley Caldera near the Hot Creek Hatchery by the Great Basin Unified Air Pollution Control District (WESTEC Service, Inc., 1986). It is believed that natural geogenic sources, hot springs and fumaroles, in the immediate vicinity of the monitoring station were the principal source of the H_2S. Hot springs and fumaroles in the project vicinity are also believed to be natural sources of H_2S emissions.

3.1.1.2.2 Hydrocarbons

Volatile hydrocarbons represent a broad spectrum of naturally occurring and man made substances. Hydrocarbons are not criteria air pollutants but are recognized as precursors of photochemical oxidants, including ozone, formed through atmospheric photochemical reactions.

TABLE 3-1: NONCONDENSABLE GASES CONTAINED WITHIN WELL SF 35-32/a/

Noncondensable Gases	Concentration (mg/l)
Ammonia	0.26
Argon	0.02
Carbon Dioxide	950
Hydrogen	<0.01
Hydrogen Sulfide	6.04
Methane	<0.001
Nonmethane Hydrocarbons	Not Analyzed/b/
Nitrogen	1.52

/a/ Well flow test September 4 to 6, 1986.
/b/ Total collective nonmethane hydrocarbon content is typically less than the methane content of geothermal fluids.

SOURCE: Pacific Energy

The tendency for different hydrocarbons to enter into photochemical reactions varies widely. This relative tendency is referred to as reactivity. Some hydrocarbons such as methane are nearly inert with respect to photochemical reactions; others such as unsaturated hydrocarbons (olefins) and aromatic hydrocarbons (substances containing one or more benzene rings structures) are very reactive. Sources of reactive hydrocarbons into the atmosphere include vehicular traffic; vegetation, particularly trees (predominantly terpenes and hemiterpenes); and the Mammoth-Pacific I geothermal power plant (MP I). Isobutane is a simple alkane (saturated hydrocarbon) and is considered slightly reactive.

At the MP I plant, sources of fugitive emissions of isobutane resulting from maintenance operations; the turboexpander; and miscellaneous seals, flanges, joints, and valves averaged about 4.6 cubic feet per minute (approximately 1,000 lbs per day) until April 1987 (Asper, W., 1987). Since that time, fugitive emissions have been reduced and are currently 188 lbs/day (Pacific Energy, 1988 Report).

At atmospheric pressure and 15°C (59°F), isobutane is a gas. Other physical characteristics of isobutane are shown in Table 3-2.

TABLE 3-2: PHYSICAL CHARACTERISTICS OF SELECTED HYDROCARBON FLUIDS/a/

Characteristics	Propane	Isobutane
Chemical Formula	$CH_3CH_2CH_3$	$(CH_3)_2CHCH_3$
Formula Weight	4 9 grams	58.12 grams
Form and Color	Colorless Gas	Colorless Gas
Specific Gravity	0.585	0.60
Boiling Point	-42.2°C (-44°F)	-10°C (14°F)
Solubility in Water	6.55 cc/100 cc	Insoluble
Flash Point (Est.)/b/	-156°F	-120°F
Flammable Limits (% Volume in Air)	2.1 to 9.5%	1.8 to 8.4%

/a/ Chemical Engineer's Handbook, Fifth Edition, 1973, Perry, R.H., and C.H. Chilton (eds.), McGraw-Hill Book Company.
/b/ Material Safe Data Sheets, Product Manufacturers.

3.1.1.3 Regulatory Framework

Local air quality must meet both federal and state ambient air quality standards as enforced locally by the Great Basin Unified Air Pollution Control District. Stationary sources of aerial emissions must also satisfy the Rules and Regulations of the Great Basin Unified Air Pollution Control District. The Great Basin Unified Air Pollution Control District has developed specific regulations with respect to H_2S and isobutane emissions from geothermal sources./1/

/1/ The MP I facility is currently operating under a permit to operate issued by the Great Basin Unified Air Pollution Control District. Reportable emissions of isobutane for the initial reporting period ending July 1, 1988, averaged 188 pounds per day within the allowed fugitive losses of 250 pounds per day per unit (Pacific Energy, 1988 Report).

Permits (Authority to Construct) would be required for all geothermal production and injection wells prior to drilling. Permits to Operate the wells would also be required from the District before commercial operation. The potential for unacceptable emissions of H_2S during drilling and testing operations is of specific concern. The Great Basin Unified Air Pollution Control District limits emissions from geothermal wells to 2.5 kg per hour per well (about 5.5 lb per hour per well). The state ambient air quality standard for H_2S is 0.03 ppm. There are no federal emission standards for H_2S.

Similarly, the Great Basin Unified Air Pollution Control District will require a permit for Authority to Construct and a Permit to Operate the PLES I geothermal power plants. The power plant will not be a source of stack emissions; however, the power plant could be a significant source of fugitive emissions of isobutane working fluid from leaking equipment, pipes, flanges, and fittings. While isobutane is not a photochemically reactive solvent as defined by Great Basin Unified Air Pollution Control District Rule 417(J); non-methane hydrocarbons, as a group, are generally considered primary air pollutants because of their role in atmospheric chemical reactions which generate secondary criteria oxidant air pollutants for which both state and federal ambient air quality standards exist. As such, fugitive hydrocarbon emissions in excess of 250 pounds per day may be subject to Great Basin Unified Air Pollution Control District New Source Performance Requirements [Rule 209-A(B.2.a)]. Such sources could be required to employ Best Available Control Technology [Rule 209-A.(D.)] to mitigate fugitive hydrocarbon emissions (Hardebeck, E., 1987).

3.1.2 GEOLOGY, SOILS, AND EROSION

3.1.2.1 Regional Geologic Setting

The project area is located within the Long Valley Caldera, an elliptical depression covering approximately 172 square miles on the eastern front of the Sierra Nevada in southern Mono County, California. The long axis of the ellipse is aligned east-west and measures 19 miles in length; the short axis is eleven miles long. The caldera is bounded on the south and west by Sierran granitic rocks of Jurassic-Cretaceous age and older metamorphosed volcanic and sedimentary rocks present as roof pendants within the granitic rocks. A prominent Tertiary-Quaternary volcanic ridge forms the northern boundary and an unnamed dissected volcanic tableland, also of Tertiary-Quarternary age, forms the eastern caldera margin.

Long Valley proper is a northwest-trending depression in part occupied by the Owens River and Lake Crowley. The primary drainage direction within the caldera is from west to east and from north to south. Most intra-caldera streams are tributaries of the Owens River or flow directly into Lake Crowley.

Volcanism within Long Valley region began approximately three million years ago. A massive caldera-forming event occurred approximately 700,000 years ago with the catastrophic eruption of 600 cubic kilometers of pyroclastic flows and ash falls (Hill D.P., et al., 1985a). The accumulated ash deposits overlie the Sierran basement rock and are known as the Bishop Tuff. Post-caldera rhyolites erupted episodically between 700,000 and 600,000 years ago, accumulating within the caldera and overlying the Bishop Tuff to a thickness of at least 1,500 feet. During this time the west-central part of the caldera floor was uplifted to form a resurgent dome. Between 500,000 and 100,000 years ago, porphyritic rhyolite lavas erupted in the north, south, and west moats on the periphery of the resurgent dome. The resurgent dome is roughly circular in shape (approximately seven miles in diameter), and has been broken by faulting into a complex series of blocks, bounded by normal faults. These faults have an overall northwest trend, paralleling the primary direction of regional faulting (see Figure 3-4, Hydrology Section). Rim eruptions of porphyritic rhyodacites occurred 200,000 to 50,000 years ago. The eruption of basaltic to trachyandesitic lava flows and cinder cones in the south and west moats were synchronous with these rim volcanics. The most recent volcanic activities are the phreatic eruptions at the Inyo Domes and Inyo Craters in the northwest corner of the caldera and beyond the northwest rim (GeothermEx, Inc. 1986). The youngest of these domes is approximately 700 years old, and it has been estimated that the craters were formed about 450 years ago.

3.1.2.2 Local Geologic Setting

The project area is located along the southwestern edge of the resurgent dome of the Long Valley Caldera. Much of the subsurface geology has been determined by geothermal well drilling activities in the area. The surface geology is dominated by post-caldera rhyolite lavas which form the resurgent dome and the moat basalt/andesite. A thin alluvium of 10 to 40-foot thickness covers these flows in most locations. The moat basalts and andesites are dark grey, porphyritic flow rocks with plagioclase and rare olivine crystals contained in aphanitic groundmasses. The basalt's north contact approximately follows Old U.S. Highway 395 in the area near Casa Diablo Hot Springs (Casa Diablo area).

Immediately below these basalt flows is a 1,200 to 1,500 foot thick rhyolitic lava interval. This post-caldera series of rhyolite flows with minor interbeded tuffs is the rock which forms the resurgent dome and constitutes the geothermal reservoir currently being exploited in the Casa Diablo area. Below the rhyolites is an 80 to 140 foot thick "landslide" horizon that is composed of granitic and metasedimentary lithic clasts which may represent a paleosol.

The Bishop Tuff occurs beneath the "landslide" horizon. One deep well drilled in the Casa Diablo area, Union Mammoth #1, penetrated the full thickness (3,250 feet) of the Bishop Tuff and drilled into basement rock.

3.1.2.3 Geothermal Production and Injection Reservoirs

The Casa Diablo geothermal production reservoir interval is approximately 300 to 600 feet below the surface within highly fractured rhyolite lavas. Lost circulation during drilling operations and sudden increases in penetration rate indicate open fractures within the reservoir. The rhyolite appears to be the reservoir lithology mainly because it is brittle and hard, which allows the rhyolite to fracture and to maintain open fractures, as opposed to the overlying basalt and underlying tuffs, which fracture poorly and do not tend to maintain large open fractures.

At Casa Diablo the proposed injection zone is below 1,000 feet, within the uppermost portion of the Bishop Tuff. The zone has uniformly high porosity and low density. During earlier drilling of this zone, penetration rates were very fast, reaching 225 feet per hour. This top zone of the Bishop Tuff apparently has sufficient matrix and fine fracture permeability and continuity to allow fluid injection by the existing MP I injection wells without significant pressure buildup (PLES, 1986).

3.1.2.4 Geologic Hazards

The proposed project area exists within a region of earthquake activity and active volcanism. Discussed below are descriptions of seismic, volcanic, and other geologic hazards present in the project area.

3.1.2.4.1 Seismicity

The proposed project area was subjected to significant ground shaking and minor surface rupture during a series of four earthquakes with magnitudes greater than six (Richter scale) during the period May 25 to May 27, 1980 (WESTEC Services, Inc. 1986). The project area is bounded on

the west by the so-called "Taylor-Bryant" fault, which was identified on the basis of an elongated zone of ground rupture which appeared during the series of 1980 earthquakes; and the project area is bounded on the east by the Eastern Graben fault (see Figure 3-1). Extensional cracks up to 64-mm wide occurred along faults near the project area, but most cracks were less than 10-mm wide without vertical offset. However, these observations do not preclude the possibility of greater surface rupture offsets from future seismic events (WESTEC Services, Inc., 1986).

Portions of the project area are near or within the "NW 1/4 Mt. Morrison 15' Special Study Zone" defined as a fault-rupture hazard zone by the California Division of Mines and Geology (Hart, E.W., 1980). As such, those portions of the project area are subject to provisions of the Alquist-Priolo Special Studies Zones Act of 1972 which prohibits construction of structures for human occupancy across the trace of an active fault (California Public Resources Code, Division 2, Chapter 7.5). Neither the proposed, nor the alternate, power plant sites would be located within the special study zones identified by revised fault trace maps (California Division of Mines and Geology, 1982). However, portions of the production and injection well fields may be within the special study zones (see Figure 3-1).

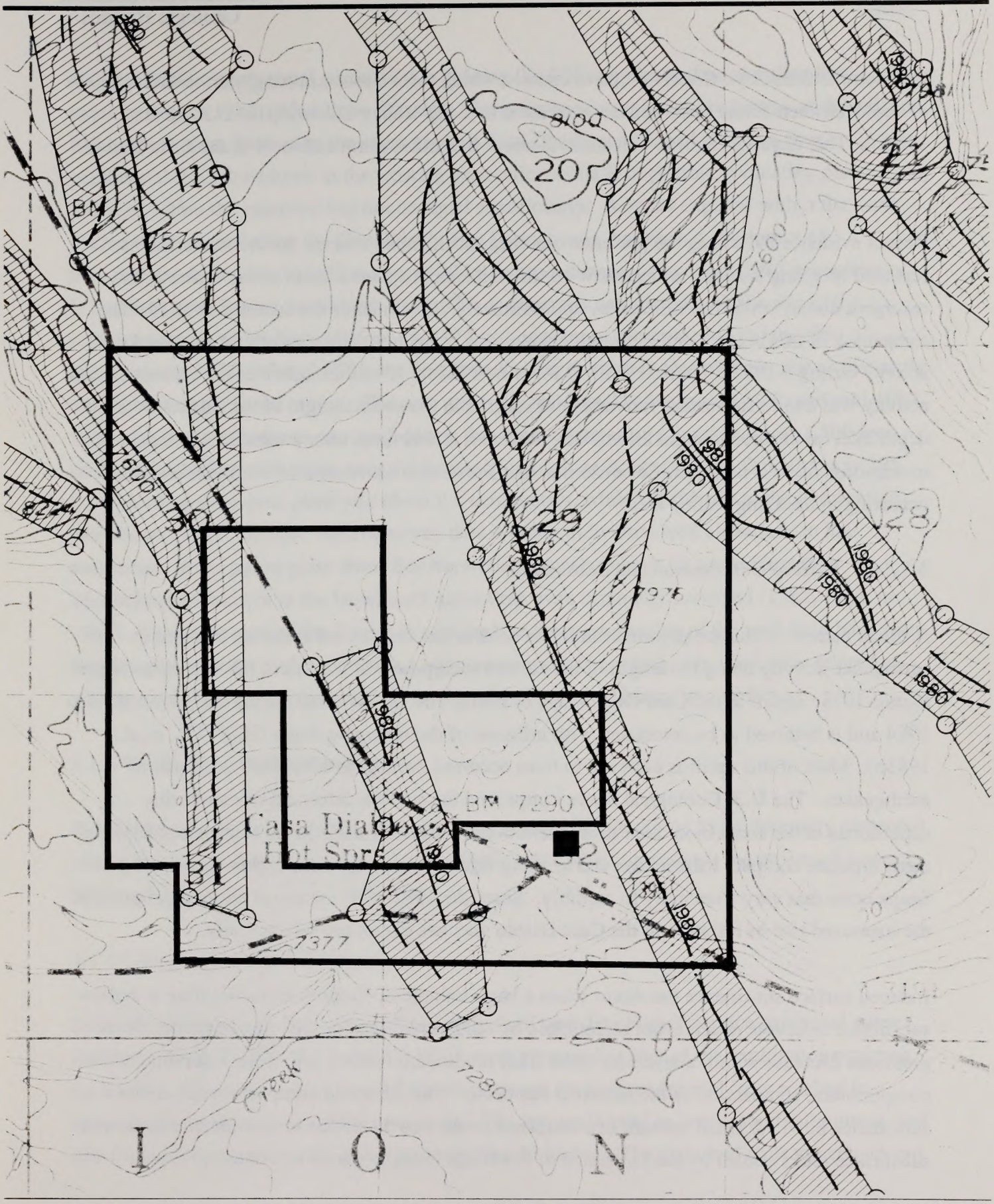
The project area would also be subject to severe ground shaking during a major earthquake. The California Division of Mines and Geology designate the region in a Severity Zone III (high) where the intensity of the maximum expectable earthquake would be IX or X on the Mercalli Intensity Scale (potential that most masonry and frame structures are destroyed, and some wooden structures destroyed). The project area is within Seismic Risk Area 4 as defined by the Uniform Building Code recognized by the state of California, and all buildings and other structural facilities would be subject to zone 4 design and construction criteria (International Conference of Building Officials, 1985./2/ Mono County currently uses the 1985 Edition of the Uniform Building Code for all structural building standards adopted in March 1988 (Mono County Public Works Department, 1988).

3.1.2.4.2 Volcanic Hazard

Geophysical evidence indicates that one or more active magma chambers exist beneath the Long Valley Caldera. The most recent volcanic activity in the Long Valley region is associated with

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/2/ The UBC defines seismic zone 4 as those areas in close proximity to major fault systems subject to intensity VII or greater of the Modified Mercalli Scale.



Proposed Power Plant Site

SOURCE: California Division of Mines and Geology

FIGURE 3-1
Identified Faults and Alquist-Priolo Special Study Zones Within the Casa Diablo Area, Mono County, California

the Mono Craters-Inyo Craters eruptive centers, which form a four-km-long, northtrending chain of vents between Mono Lake and the west moat of Long Valley Caldera (Hill D.P., et al., 1985b). This chain of rhyolite volcanoes is about five miles north and west of the Casa Diablo area.

Recent evidence indicating the presence of a magma chamber beneath the caldera includes repeated levelling surveys, which show an inflated area, displaced south of the center of the resurgent dome, which has inflated by approximately 100 cm since the summer of 1979. The steepening of this bulge along the south caldera was correlated with a swarm of earthquake activity during a 1982-83 period (Hill, D.P., et al, 1985a). It was thought that the seismic swarm activity was due to subsurface movement of magma in the south margin of the caldera over a depth interval of three to eight kilometers; however, at this time, after a substantial amount of monitoring, there is no scientific consensus that subsurface movement of magma is actually occurring in the Long Valley area.

3.1.2.4.3 Surface Deformation and Subsidence

A broad pattern of surface deformation in the caldera has been noted since the increase in earthquake activity along the length of the eastern escarpment of the Sierra Nevada range began in mid-1978. Uplift in the Casa Diablo area of nearly 100 cm occurred during the period 1978 to 1984 and is believed to be associated with inflation of the resurgent dome (Hill, D.P., et al., 1985b). Most of this uplift is believed to have occurred during the May 1980 sequence of earthquakes. The U.S. Geological Survey improved the surface deformation monitoring capabilities in the south moat area subsequent to the May 1980 earthquake sequence to include three separate compact trilateration and leveling figures which have since been measured with frequencies that vary from daily to monthly. Since the 1982-1983 swarm of earthquake activity, the measured rate of inflation in the Casa Diablo area has decreased substantially.

Induced surface subsidence can occur when a large volume of fluids is extracted from a shallow subsurface reservoir which is not replenished by natural recharge or injection of fluids. Pore pressures decrease within a reservoir when fluid production occurs, and, if the reservoir rock is compressible, compaction of the reservoir can occur. This reservoir compaction can create a subsidence bowl. A small amount of subsidence could also occur due to thermal contraction of subsurface rocks cooled by the extraction of hot fluids being replaced by cooler fluids.

At Casa Diablo, geothermal production supplying the MP I geothermal power plant has continued since 1984. After three (3) years of continuous commercial production at the existing MP I power plant, located in the same general Casa Diablo geothermal resource area, geothermal fluid drawdown in the existing production wells is negligible, indicating pore pressure within the reservoir has not changed significantly. A broad expanse within the Long Valley Caldera, including the Casa Diablo Hot Springs area, has risen a maximum of 0.15 meters, decreasing to 0.02 meters at 30 kilometers distance, since mid-1983 according to U.S. Geological Survey benchmark data. This is generally associated with the rise of the resurgent dome, which began before the MP I power plant began operation in late 1984. Between mid-1985 and mid-1986, the benchmarks near the power plant did not rise as fast as the other benchmarks in the region. The area generally stabilized between mid-1986 and mid-1987, and some slight subsidence occurred during this time, centered at a location about 1,500 feet south of the MP I power plant, near the intersection of State Route 203 and Old Highway 395. Subsidence at the power plant was about 0.6 centimeters, while subsidence at the intersection was about 1.8 centimeters. Recent survey data relating individual well elevations to the benchmark at the power plant show that the wells themselves have all moved less than 15 centimeters relative to the benchmark since they were originally surveyed (1982, 1983, or 1984). The wells west of the Taylor Bryant fault at the western edge of the well field have risen less than those to the east, suggesting a tectonic relationship, which may have been related to movement during the November 1984 earthquake (Mesquite Group, Inc. 1988).

3.1.2.4.4 Shallow Geothermal Fluids

Resistivity surveys conducted by SEA, Incorporated (1988) identified hydrothermally cemented soil layers which suggest that there may be shallow hot water or steam at the proposed power plant site.

3.1.2.5 Soils and Erosion Potential

Soils within the project and alternate site were field tested by Forest Service personnel when well sites SF 25-32, SF 35-32, and SF 45-32 were proposed as part of the exploration program for PLES I. The soils overlie basalt bedrock but were themselves formed from washed in material of granitic or rhyolitic source rocks. The texture is sand or loamy sand throughout, and soil thickness ranges from 40 inches to more than 60 inches. The disturbed soils are considered

highly susceptible to wind and water erosion. As a result of their sandy textures, the soils are also highly susceptible to mechanical erosion by vehicular traffic (BLM, 1986a). Similar soil sampling was done when exploratory wells for the MP II & III project were proposed. Sample locations were near the SCE substation (see Figure 2-1 and Table 3-3). Analysis revealed highly erodible soils similar in character to those described above (BLM, 1986b).

According to a recent resistivity survey conducted at the proposed power plant site (SEA Inc., 1988), six soil units were found overlying bedrock (basalt). Two layers were found to be considerably more resistive than other overlying or underlying layers. These layers, which consist of sinter, a hydrothermally cemented alluvium, were found to be difficult or impossible to penetrate when encountered in auger borings.

According to a biotic survey of the Casa Diablo area, the soils of the entire proposed and alternate power plant sites are undisturbed (Taylor, D.W. and Buckberg, R., 1986).

TABLE 3-3: SOIL INTERPRETATIONS

Site	EHR	EHR Maximum	WEG	AWC (Inches)
SF 25-32	Low-Mod.	High	High	3.0-4.8 (Low)
SF 35-32	Low-Mod.	High	High	2.8-3.9 (Low)
SF 45-32	Low-Mod.	High	High	1.9-2.5 (Very Low)

EHR = Erosion Hazard Rating of the Soil Under its Present Conditions.
EHR Maximum = Erosion Hazard Rating of the Soil When it is Disturbed.
WEG = Wind Erodibility Group is a Measure of the Susceptibility of the Soil to Wind Erosion.
AWC = Available Water Capacity of the Upper 60 Inches of Soil.

SOURCE: Bureau of Land Management. 1986. Environmental Assessment. Serial Number CA-017-P006-37.

3.1.3 NOISE

3.1.3.1 Regulatory Framework

The Noise Element of the Mono County General Plan identifies goals and policies to attain and maintain acceptable noise levels. The Element requires an acoustical analysis prior to construction of any noise-sensitive land uses in areas that are currently exposed to day-night equivalent noise levels (L_{dn}) of 60 or more./3,4/ In addition, the Element requires an acoustic analysis for projects that would generate high noise levels in areas where existing noise levels are less than 60 dBA, L_{dn} (Mono County, 1981). The Element also contains recommendations for mitigating noise, for new noise sources that exceed community noise compatibility guidelines.

Mono County Ordinance 79-479 requires that constructing and grading activities within 500 feet of residential or commercial occupancies, can only occur between 7 a.m. and 8 p.m. Monday through Saturday and between 9 a.m. and 5 p.m. on Sundays. This ordinance is enforced by the Mono County Sheriff.

/3/ Noise is customarily measured in decibels (dB), units related to the apparent loudness of sound. Because the human ear is more sensitive to some frequencies than others, sound measured by an instrument (noise meter) is typically altered electronically so that it approximates what would be heard by the human ear. Units of noise measurement recorded by the meter are termed "A-weighted decibels" (dBA). Noise levels associated with some typical activities are listed below:

Sound Pressure Level (dBA, Le_q	Example of Source
110	Jet takeoff at 2,000 feet
100	Shouting in ear
90	Pneumatic drill at 50 feet
80	Freight train at 50 feet
70	Freeway traffic at 250 feet
60	Hospital incinerator at 50 feet
50	Quiet conversation at 10 feet
40	Rural environment at night
30	Soft whisper

SOURCE: Cuniff, P.W., 1977; Honour, W.W., 1979.

/4/ Because environmental noise levels fluctuate with time, a time-averaged noise level in dBA is used to characterize the acoustic environment at a given location. The "day-night equivalent noise level" (L_{dn}) is a 24-hour time-averaged noise measurement to which a 10-dBA "penalty" is added between 10:00 p.m. and 7:00 a.m. to account for greater nighttime noise sensitivity.

The U.S. Geological Survey, Conservation Division, has issued seven Geothermal Resources Operational (GRO) Orders. These operational orders have been adopted into federal regulation and pertain to all geothermal lessees on federal lands. GRO Order No. 4 calls for noise to be measured according to specific procedures, with equipment that meets performance specifications. Muffling devices for noise attenuation are also defined. Under GRO Order No. 4, the lessee must comply with federal occupational noise exposure levels or state standards for protection of personnel, whichever are the more restrictive. Unless a more restrictive level is set by the authorized officer, the maximum noise exposure levels are set at an energy-equivalent noise level (L_{eq}) of 65 dBA for all geothermal-related activity, as measured at the lease boundary or at 0.8 kilometers (one-half mile), whichever is greater (U.S. Geological Survey, Conservation Division, 1976)./5/

3.1.3.2 Noise Sources and Levels

Twenty-four-hour average noise levels were measured on the proposed project site between the 8th and 11th of January, 1987 (see Table 3-4). The major noise source in the project area is the existing MP I geothermal power plant located about 800 feet to the west of the proposed power plant site.

Operation of the MP I plant produces a continuous high level hum which has been measured at 63-66 dBA L_{eq} at 150 feet. Major sources of noise from the plant include the expander turbines, the air-cooled condenser fans, and the piping between the expanders and condensers.

Noise control retrofitting of the MP I plant resulted in 10 to 12 dBA, L_{eq} noise reductions. The current noise level recorded at 0.5 mile distance is approximately 40 dBA. The noise level adjacent to the MP I plant along Hot Springs Road is 69dBA (Asper W., 1987a).

Vehicular noise in the project area is negligible. Hot Springs Road, which passes through the project area, is lightly travelled (no traffic counts have been taken since plant construction). The closest heavily travelled highway is Highway 395, approximately 3,500 feet to the south of the proposed power plant site. Noise from this source was observed to be inaudible during a January site visit by ESA staff, due to distance attenuation and the higher sound levels generated by the nearby MP I plant (see Table 3-3).

/5/ The "energy equivalent noise level" (L_{eq}) is the average noise intensity over a given period of time.

TABLE 3-4: 24-HOUR NOISE LEVELS NEAR CASA DIABLO HOT SPRINGS/a/

Proposed Power Plant Sites	Time Period	Noise Levels dBA, L_{eq}	dBA, L_{dn}/b/
PLES I/c/	07 p.m. to 10 p.m.	75	78
	10 p.m. to 07 a.m.	76	
	07 a.m. to 07 p.m.	75	
MP II and III/d,e/	07 p.m. to 10 p.m.	60, (59)	
	10 p.m. to 07 a.m.	60, (60)	66, (66)
	07 a.m. to 07 p.m.	59, (58)	

/a/ All measurements were taken between January 8th and 11th, 1987 with a Metrosonic model dB-306A Metrologger noise meter with wind screen calibrated prior to each use.
/b/ The L_{dn} is based on the L_{eq}, but incorporates a 10-dBA penalty for noise levels measured between 10 p.m. and 7 a.m.
/c/ Measurement was made 200 feet south of Hot Springs Road and 50 feet east of an access road which separates the MP I site from the proposed PLES I site.
/d/ Measurement was taken about 35 feet northeast of Union Mammoth Well No. 1.
/e/ Two measurements were taken at this site; the calculated L_{dn} for both measures was identical.

SOURCE: Environmental Science Associates, Inc., 1987

Intermittent aircraft noise is probably audible due to low-flying aircraft approaching and departing from Mammoth/June Lakes airport and about four miles to the east of the project site. Other sources of intermittent noise may be recreational vehicles (noise from which is controlled by the State Vehicle Code, Section 38365-A) and wood-cutting activities, which are controlled by use permits.

3.1.3.3 Noise-Sensitive Land Uses

The closest noise-sensitive concentrated land use is the Sherwin Creek Campground one and one-half miles southwest of the project area. The closest residence is at Chance Ranch, one and one-half miles to the east. Residences at the Hot Creek Hatchery are about three miles to the east-southeast. County office buildings are located about one and one-half miles to the east. The John Muir Wilderness Area is about 2.5 miles to the south of the project site. Dispersed

recreational use (hunting, firewood gathering, target practice) occurs within one mile of the proposed project plant site and within a few hundred yards of the alternate site (see Section 3.3.3, Recreational Resources).

3.1.4 HYDROLOGY

3.1.4.1 Conceptual Models of the Geothermal Reservoir

In order to answer questions about potential interactions between aquifers in the area, a hydrologic model is necessary. Scientists working in the area have proposed two different conceptual models, both of which can be supported by observed data.

One model, called the Lateral Flow Model, is based on the assumption that the geothermal fluid originates deep near the western or southwestern edge of the caldera and moves up and then east in shallow rocks through the caldera towards Lake Crowley. In this model, the hot water migrates up faults until it encounters shallow rock through which eastward flow can be maintained. This model assumes a single deep hot water resource supplying all the thermal features in the area. The characteristics of the water at each feature would be the result of mixing thermal water and meteoric water in different proportions. This model implies that production of hot fluids from one zone and injection into another could result in pressure and/or temperature declines in nearby areas which are hydraulically connected to the same lateral zones.

The second model is called the Upwelling/Fracture Flow Model. Under the scenario proposed by this model, the nearly vertical faults which cut across the area serve as conduits to carry heated water up from deep reservoirs. It has been suggested that fluids move from south to north, roughly along the strike of the major faults (GeothermEx, Inc. 1986). This would suggest poor hydraulic connection between reservoirs for each thermally active area and little potential for interference between the Casa Diablo area and Hot Creek Hatchery or Hot Creek Gorge.

The following discussion of the surface and subsurface hydrologic resources briefly summarizes the current knowledge about the area. It is a summary of a report on the hydrology of the project area written by Berkeley Group Incorporated (BGI). The report is included as Technical Appendix C in this document. Details and additional references can be found in the BGI report.

3.1.4.2 Surface Resources

The proposed project and alternative location sites are contained entirely within the Mammoth Basin, an area of approximately 60 square miles, which is defined by the surface watershed of Mammoth and Hot Creeks (including Sherwin and Laurel Creeks). These creeks flow across the Long Valley Caldera to the Owens River and then into Lake Crowley. Other small creeks in the vicinity include Dry Creek, Little Hot Creek, and Convict Creek. In addition to the creeks which drain the area, a number of springs contribute to surface flows. Locations of the creeks are shown on Figure 3-2. Flow data, temperatures, and water chemistry analyses are summarized in Table 3-5. The table contains average values which do not reveal seasonal changes. A more extensive summary of chemical analysis is given by Farrar et al., (1985).

The following discussion of surface hydrology describes these features: an unnamed intermittent creek which drains the project site; Mammoth Creek; Hot Creek; and five springs, or groups of springs, which ultimately flow into Hot Creek.

3.1.4.2.1 Creeks

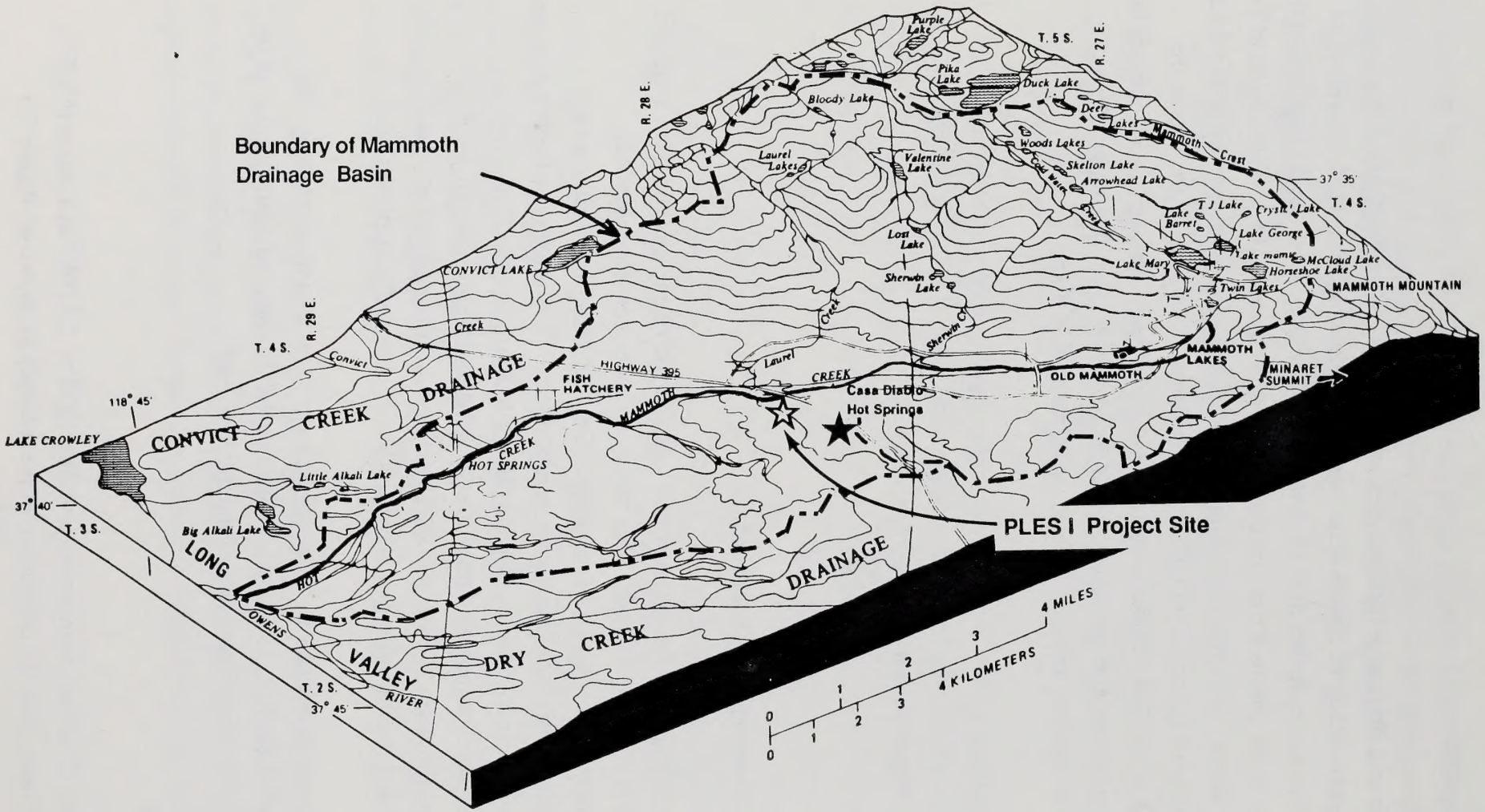
(a) Unnamed Creek Draining Casa Diablo Area

The primary surface drainage feature in the project and alternative site location is an unnamed intermittent tributary to Mammoth Creek. This creek originates near Highway 395, approximately one-half mile northwest of the project site, and joins Mammoth Creek approximately 0.6 mile south of the proposed power plant site. The stream discharge rate varies seasonally from zero to 1.5 cubic feet per second (cfs). Flow rate and fluid chemistry are dependent upon the relative contribution from the Casa Diablo Hot Springs. In years with above normal late season precipitation, the stream flows year-round. An unmeasured amount of creek flow is believed lost into the thin alluvium between Casa Diablo and Mammoth Creek.

There is no known chemical analysis available of the water from the unnamed creek. The chemistry of the steam is likely to vary considerably depending upon the relative influx of hot spring waters. No human consumptive use of the tributary exists.

(b) Mammoth Creek

The flow in Mammoth Creek has been monitored since 1932 by LADWP at a flume (MCF) a short distance downstream from the confluence of the tributary as shown on Figure 3-3



☆ Proposed Site

★ Alternative Site

SOURCE: BGI, 1987

FIGURE 3-2
Surface Drainage Features
of the Mammoth Creek Basin

TABLE 3-5: AVERAGE FLOWRATE, TEMPERATURE, AND CHEMISTRY DATA FOR PROMINENT SURFACE HYDROLOGIC FEATURES

Features	Flowrate (cfs)	Temp. (C°)	Selected Chemical Constituents (mg/l) TDS*	CI	F	B	Li	Si02
Unnamed Stream at Casa Diablo	<1	---	Variable Chemistry Exists					
Mammoth Creek at Highway 395	22	10 (50°F)	Variable Chemistry Exists					
Below Hot Creek Gorge Flume (HCF)	52	24 (75°F)	Variable Chemistry Exists					
Casa Diablo Geyser (CDG)	0.35	91 (196°F)	1,350	290	13	12.5	3.5	300
Colton Spring (CS)	0.03	93 (199°F)	1,300	260	11	11.5	2.9	250
Hot Creek Hatchery (AB, CD, H1, H2,3)	17-28	13 (55°F)	112	2	0.25	0.009	0.004	36
Hot Creek Spring (HC-2)	---	82 (180°F)	1,140	220	10	10	2.6	140

*TDS = Total Dissolved Solids

SOURCES: California Department of Water Resources, 1967 and 1973; Farrar, et al., 1985 and 1986; Setmire, J.G., 1984; and Clark, M., 1988.

(California Department of Water Resources, 1967 and 1973). Discharge rates vary between 3,000 and 40,000 acre feet per year at this point. During certain times of the year a portion of the flow is lost to shallow ground water in the meadow between Highway 395 and Hot Creek Hatchery. An unknown quantity is diverted during summer months by a local rancher, which may account for some (or perhaps most) of the loss downstream of MCF.

The quality of water in Mammoth Creek is generally very good above Highway 395, but begins to degrade as hot spring discharge adds total dissolved solids and increases the temperature and grazing results in fecal coliform and nutrient inputs.

(c) Hot Creek

Hot Creek originates in the meadow above Hot Creek Hatchery where a group of springs emerge. The spring water flows through the hatchery and continues downstream as Hot Creek. Effluent from the hatchery contributes approximately 17 to 28 cfs to the flow of Hot Creek. This figure was obtained from measurements of flow rate at the springs. Actual flow rates may be higher if there are surface drainage contributions to the creek (Sorey, M.L., 1976; Farrar, et al., 1985).

Hot Creek is also monitored at the flume (HCF) below Hot Creek Gorge. This site has been used to gauge stream flow since 1923 and has most recently been used to collect data on the rate of discharge from the springs in Hot Creek Gorge relative to total stream flow. Stream flow at HCF varies between 25,000 and 80,000 acre feet per year and averages approximately 40,000 acre feet per year (California Department of Water Resources, 1967). Of this total, approximately 7,000 acre feet per year (average 9.5 cfs) is contributed by hot springs along the gorge (Farrar, C.D., 1985).

Chemical analysis of samples taken at HCF indicate that most of the dissolved mineral load is due to discharge from thermal springs along Mammoth and Hot Creeks (California Department of Water Resources, 1967, 1973; Setmire, J.G., 1984). Under the present conditions, the water in Hot Creek at this point (HCF) has some biologic contamination and may not be recommended for human consumption (Setmire, J.G., 1984).

3.1.4.2.2 Thermal Springs

Numerous hydrothermal features are found from the Casa Diablo area to the Hot Creek Gorge area (see Figure 3-3). These consist of springs of various temperatures and discharge rates and gas-emitting fumaroles. Some of these features maintain a relatively constant level of activity from year to year; others are intermittent and may change or disappear entirely. All springs and fumaroles are subject to fluctuation and possible extinction due to seismic activity and natural precipitation of calcium carbonate.

(a) Casa Diablo

There are several surface thermal features in the Casa Diablo area. The most prominent is the Casa Diablo Geyser (CDG) located immediately northwest of the MP I geothermal power plant.

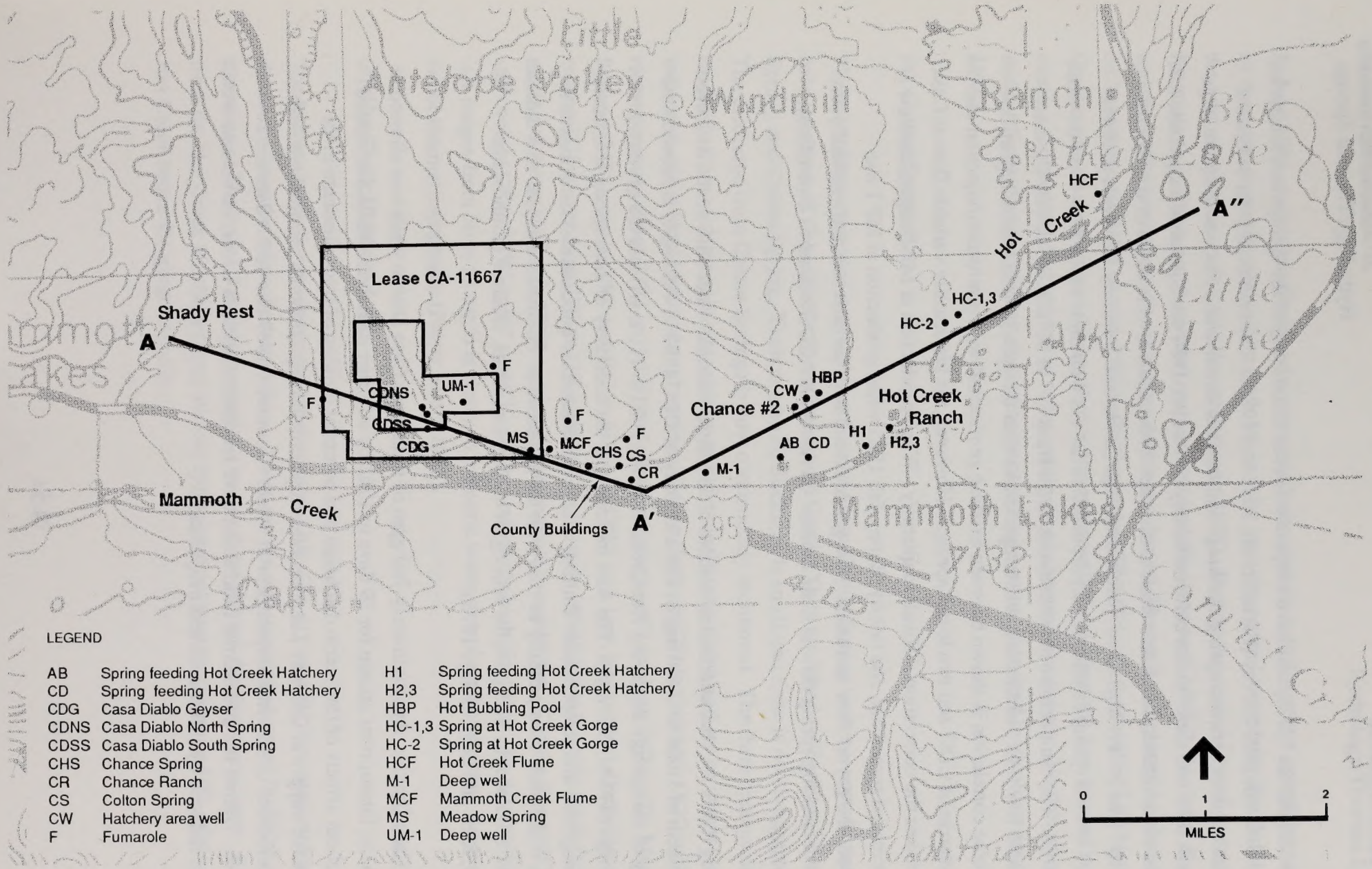


FIGURE 3-3
Location of Faults, Thermal Features and Wells in the Southwest Long Valley Area

SOURCE: BGI, 1987 and ESA

The operators of the MP I plant have cooperated in the monitoring of the springs and fumaroles by the U.S. Goelogical Survey (Farrar, et al., 1985 and 1986). The results thus far indicate a distinct correlation between spring discharge and tectonic strain events, as shown by the large increase in flow rate three weeks before a nearby November 1984 earthquake of magnitude 5.8. Historical observations which date back to the late 1800s report a wide range of activity from "geysering" tens of feet high to no visible discharge (Lawrence Berkeley Laboratory, 1984). Estimates of total spring discharge vary from 0.0 to 1.4 cfs with most of the flow from the main vent (CDG). The temperature measurements range from 80° to 90°C (176° to 194°F); the springs with low flow rates have lower temperatures than the springs which have higher flow rates. Some correlation is shown between existing geothermal well production/injection and the total discharge at CDG and two lesser springs. However, the historically variable flow at Casa Diablo makes the correlation difficult to quantify. When production at MP I began, the flow at CDG decreased somewhat, and briefly, during fall 1985 when production at MP I was interrupted, the geyser flow increased. The general trend over the past two and one-half years has been decreasing spring flow at Casa Diablo. In April 1987 CDG ceased to flow (Sorey, M.L., 1987a).

Hot spring fluids are characterized as sodium bicarbonate-chloride water with a total dissolved solids content of 1,000 to 1,400 mg/l. The alkalinity of CDG (382 to 469 mg/l) is between the alkalinity of the springs supplying Hot Creek Hatchery, (70 to 110 mg/l) and the geysers at Hot Creek Gorge (471 to 490 mg/l). The data indicate that the chemistry of each spring is affected by discharge rate and temperature. Boiling near or on the surface concentrates constituents in the fluid, which may then partially re-mix with the condensate. Published analyses also indicate a complex relationship with possible mixing of cooler, less saline, shallow groundwater (Mariner, R.H. and L.M. Wiley, 1976).

Spills at Casa Diablo: Approximately 760 gpm of fluid from Casa Diablo wells was allowed to flow into the intermittent stream for 39 days in 1962 by a former operator. While this caused concern about effects of long-term discharge and potential buildup of trace elements in the potable water supply at Crowley Lake, no catastrophic or lasting effects to the creeks or lake were documented (California Department of Water Resources, 1967 and 1973; Setmire, J.G., 1984). Before the geothermal fluid could have reached Mammoth Creek, its volume would have been reduced by infiltration and evaporation.

In June 1984, during installation of a pump, a block valve on a well was not completely closed by the crew at quitting time, allowing brine to flow onto the ground overnight. No fluid reached the intermittent stream draining the area (Asper, 1988). During the period July 15 to July 18, a fumarole (i.e., steam not hot water) erupted near and finally at well MPP-2. No brine flowed and the well was quenched by pumping cold water into it. The well was plugged and abandoned on September 12, 1984 (Asper, 1988). On September 29, 1984, endogenous well #2 blewout. Condensing steam plus some water flowing from the well flowed into the intermittent stream, causing erosion and degradation of water quality in the intermittent stream. No fish were killed and the Forest Service weir on the intermittent stream was not damaged by the blowout (Asper, 1988).

(b) Colton Spring Area

There are three groups of small springs located in the Colton Spring vicinity, approximately one mile southeast of Casa Diablo, along Mammoth Creek. They are Meadow Springs, Chance Spring, and Colton Spring. Their combined discharge is small and there is no consumptive use. The discharge from Colton Springs is now continuously monitored. The three springs differ markedly from each other in temperature and chemical composition and are of interest as indicators of the local hydrothermal system. Colton Springs (CS) is similar to CDG with respect to temperature (about 90°C or 194°F) and chemical species (C1 is about 260 mg/l). Meadow Springs (MS) is cooler (56° to 64°C or 133° to 147°F) with low, intermittent discharge; chloride content (C1 ranges from 170 to 210 mg/l) and ionic ratios indicate that it could result from the mixing of water similar to CDG and local, near-surface groundwater. Chance Spring (CHS) is still cooler (17° to 18°C or 63° to 64°F) and has relatively high discharge. Its composition (C1 ranges from 30 to 55 mg/l) is closer to meteoric water than the other springs, suggesting a minor thermal component (Farrar, et al., 1985).

(c) Hot Creek Hatchery Area

The four major spring groups in the hatchery area (AB, CD, H1, and H2,3 located on Figure 3-3) discharge from the edge of a basalt flow. These are the only sources of water for hatchery operations. The water chemistry suggests a two to three percent thermal component. Effluent from the Hot Creek Hatchery (from all four spring groups) contributes up to 40% of the flow in Hot Creek above the gorge annually.

Hot Creek Hatchery spring discharge and temperature was stated to be relatively constant in the Joint EA/EIR (p. 3-29). However, data recently acquired from Fish and Game and monitoring by the Mammoth/Chance developer suggest rather wide fluctuations related to yearly precipitation and runoff. No adverse impacts to hatchery operations are reported to have occurred due to these conditions. Graphs of temperature and flow for springs AB, CD, H1, and H2,3 groups are in Appendix C. During this 11-year period of record for the AB springs, the temperature at the hottest spring group has varied in a given year from as much as 4°F to as little as 1°F, with an overall range of 5°F (2.8°C) for the entire 11-year period. Flowrate data at the AB springs have been collected by the Mammoth/Chance project for background monitoring since 1985. Peak flow increased up to 70% above average during the wet year of 1986 (with accompanying temperature decline), but the peak was only 12% above average during a dry year, 1987.

Similarly, the CD, H1, and H2,3 spring groups show temperature variation, though to a lesser extent. These springs may be more susceptible to a reduction of the thermal component as a result of mineral precipitation in fractures due to their lower flow rates and near surface cooling.

The most sensitive hatchery operation with regard to temperature is considered to be the broodstock ponds which currently use approximately 53°F water from the H1 spring. The temperature plots show that the temperatures in H1 have varied from under 52.5°F to slightly over 56°F at that spring. The lowest temperature spring in the cold water source area to the west is at Laurel Spring, 11.8 - 12.0°C (53.2 - 53.6°F).

(d) Hot Bubbling Pool

Another surface feature of the note in the area is the Hot Bubbling Pool (HBP), located approximately one-half mile north of Hot Creek Hatchery (Figure 3-3). This spring-fed pool is of interest because its fluid characteristics are markedly different from the springs at Hot Creek Hatchery; yet, its distance from Casa Diablo is approximately the same.

(e) Hot Creek Gorge Springs

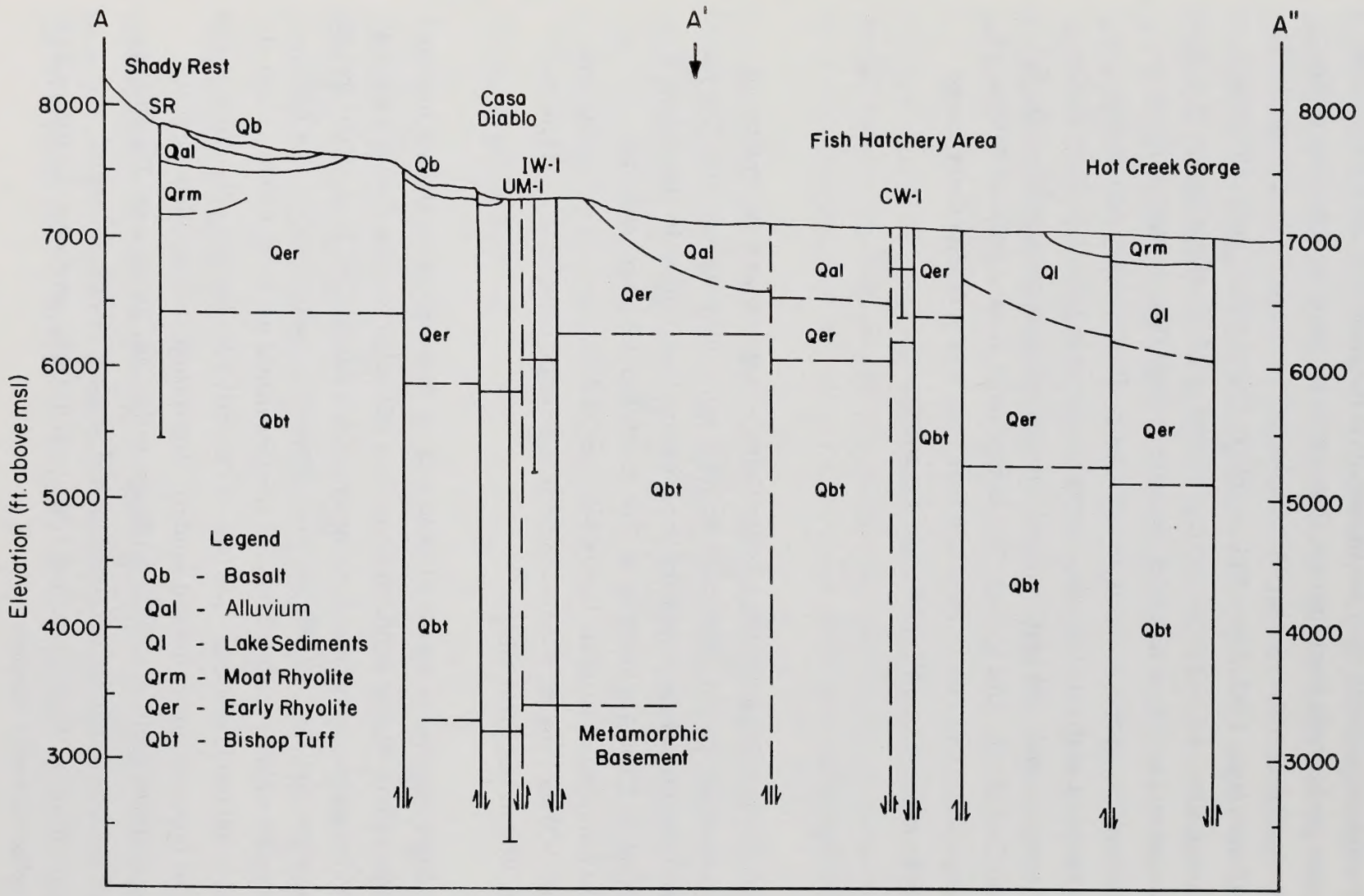
Several springs discharge at varying rates along Hot Creek Gorge (HC-1; -2; -3). These occur along two unnamed faults. Seasonal spring temperatures have varied from 90° to 94°C (194° to 201°F) at HC-1, 76.2° to 92°C (169° to 198°F) at HC-2; and 88.3° to 92.8°C (191° to 199°F) at

HC-3 during a 1983 to 1985 monitoring period. Measured fluctuations may result from spring conduit clogging and resulting flow losses. Total spring flow from this area cannot be measured directly since the major contributing vents are submerged in the creek bed. However, a close estimate of flow rate can be made from chemical flux correlation using the total flow of Hot Creek and its chemical load, measured at the U.S. Geological Survey maintained flume (HCF) below the gorge (Farrar, et al., 1985; Sorey, M.L. and M.D. Clark, 1981). Such calculations have yielded an average for total Hot Creek spring discharge of 9.5 cfs with a high of 11.6 cfs in 1980, attributed to seismic activity at that time. Increases in total flow, apparently due to tectonic strain relationships, appear suddenly and slowly die-off returning to normal flow patterns. Recent chemical analyses of the major vents are shown in Table 3-5. They display similar chemical compositions. The ionic compositions and ratios are comparable to the Hot Bubbling Pool and Casa Diablo Area springs. The isotope ratios show significant differences. No changes in temperature, flow rate, or chemistry have been seen in the Hot Creek Gorge springs which can be attributed to MP I power plant operations.

3.1.4.3 Subsurface Resources

Drilling and geophysical studies in the Long Valley Caldera have indicated the presence of thermal fluids at various depths and locations in the south and southwest areas, including the Casa Diablo area in general and the project site in particular. Deep drilling has been done at Inyo Craters (Unocal 44-16) and at Shady Rest. The depths and water chemistry are summarized in the following discussion. Figure 3-4 is an idealized cross-section (along line A-A'-A" in Figure 3-3) showing the relative locations of geologic units, faults, and selected wells from Shady Rest to Hot Creek Gorge.

Subsurface hydrologic resources in the Casa Diablo area are characterized by shallow localized cold groundwater at zero to 40-foot depth, underlain by a thermal production zone at a depth of 300 to 600 feet where temperatures range from approximately 330° to 350°F. A second thermal zone is located at depths of 2,000 to 2,600 feet (with temperatures about 305°F). The highest temperatures are found within a fractured rhyolite complex named the Early Rhyolite, located between zero and 1,500 feet in this area. The base of the Early Rhyolite also contains the cooler zone separating the upper and lower thermal aquifers. The Bishop Tuff underlies the Early Rhyolite at an approximate depth of 1,500 to 4,100 feet in the Casa Diablo area. The Bishop Tuff unit contains the second high temperature zone and displays steadily decreasing temperatures below this zone (Figure 3-4, Well UM-1). Well UM-1 penetrated the Bishop Tuff into the metamorphic basement complex.



SOURCE: BGI, 1987

FIGURE 3-4
Geologic Cross-Section Along A-A'-A" Showing the Location of Selected Wells

The major faults bounding the graben at Casa Diablo have apparently provided an avenue for the hot fluids to circulate from depth to near the surface, consistent with the Upwelling Fracture Flow Model. Higher temperatures are found in the Shady Rest well at a greater depth from the surface than at Casa Diablo, and the elevation of the high temperature zones is approximately 400 feet lower at Shady Rest than at Casa Diablo.

Two recently drilled wells in the Casa Diablo area have been helpful in defining reservoir extent. The first was production well SF 35-32, which showed that equivalent static pressures are found south of the existing MP I wells near the proposed production well field. Pump testing at rates of up to 2,100 gpm showed higher productivity than in the existing MP I Production wells with a small pressure drop in SF 35-32 and no measurable interference with existing wells (Mesquite Group Inc., 1986). Chemistry, pressure, and temperature data suggest that the well SF 35-32 is producing from the same reservoir as the MP I wells. The second well was SF 65-32 which was drilled for monitoring purposes only under recommendations from the LVHAC and required by the BLM. Temperature and chemistry data from SF 65-32 are similar to other Casa Diablo wells. Pressure data indicate communication with the production zone, though the monitoring well is only 250 feet deep.

3.1.4.4 Summary of Hydrologic Data from Wells

3.1.4.4.1 Pressure Data

Pre-1988 pressure measurements in wells currently used for production at Casa Diablo were not accurate enough for the detection of small scale trends. Although the well test done at SF 35-32 provided useful data, it did not allow analysis of small scale effects for calculation of reservoir parameters. New test data is available since completion of well SF 65-32 and post-1988 monitoring equipment upgrades. This data shows a distinct pressure response in each well due to shut in and start up of MP I wells. These data have allowed more accurate calculation of reservoir parameters which are used to estimate impacts in Chapter 4.

3.1.4.4.2 Temperature Data

Temperature data from wells in the Casa Diablo area show a localized high temperature zone in the production interval at Casa Diablo. A high temperature zone exists at depths below

1,100 feet in the Shady Rest well, and subsurface warm zones similar to those at Casa Diablo are found near the Fish Hatchery and Hot Creek Gorge. It is possible that fluid could be flowing laterally from Shady Rest through the Casa Diablo area to the Hot Creek Gorge area, cooling along the way. This is the basis for the Lateral Flow Model, it implies fluids move through or around major faults at Casa Diablo and across fault and stratigraphic boundaries toward Hot Creek Gorge. The extent of fracturing in the stratigraphic units would significantly influence fluid movement. An alternative interpretation based on the Upwelling/Fracture Flow Model is that Casa Diablo and Hot Creek are recharged by upwelling fluids from different major faults.

3.1.4.4.3 Chemical Data

Table 3-6 shows chemical and physical characteristics from wells in the Casa Diablo area. Chemical analyses may be used to suggest the source of spring waters based on the characteristics of the discharge and subsurface water. These efforts at correlation have been based on comparison of prominent chemical species that are conserved during mixing and boiling, such as: chloride (C1) lithium (Li), and boron (B).

C1/B and C1/Li ratios indicate that the ionic ratios in various spring waters are comparable between the different thermal spring areas. The data also show a trend of decreasing ionic concentration away from Casa Diablo, but with ionic ratios preserved (Shevenell, et al., in press). These data have been used to support the Lateral Flow Model describing a single source of fluids for the springs at Casa Diablo, Hot Creek Gorge, and Hot Creek Hatchery.

The stable isotope data for the same springs show large differences between the Casa Diablo springs, deep wells, and CDG. A combination of boiling and mixing of thermal and non-thermal fluids has been used to account for the isotopic data. These results may support the Lateral Flow Model based on generally NW to SE flow. However, another explanation has been proposed based on a multiple-source or Upwelling/Fracture Flow Model. It attributes differences in fluid chemistry between the thermally active areas to each having a different source of fluid that is upwelling from great depth.

At Casa Diablo, the chemistry of the reservoir fluids and the chemistry of the Casa Diablo springs, such as CDG are similar. In particular, the analyses of ionic ratios and stable isotope groups (regardless of the suggested degree of mixing by cold, near-surface, groundwater) show

TABLE 3-6: REPRESENTATIVE GEOTHERMAL FLUID CHEMICAL AND PHYSICAL CHARACTERISTICS FROM WELLS LOCATED IN OR ADJACENT TO THE PLES I PROJECT AREA

Parameter	Unflashed Samples (mg/L)				
	Well MBP-1/a/	Well MBP-3/a/	Well MBP-4/a/	Well MBP-5/a/	Well SF35-32/b/
Total Dissolved Solids (TDS)	1392	1376	1381	1382	1553
Silica Dioxide (SiO2)	254	255	240	240	275
Calcium (Ca)	3.1	1.3	1.8	6	6.1
Magnesium (Mg)	0.13	0.12	0.1	0.1	<1
Manganese (Mn)	---	0.05	---	---	<0.50
Sodium (Na)	352	350	340	340	382
Potassium (K)	35	36	35	31	39.6
Bicarbonate (HCO3)	355	345	360	360	460.7
Sulfate (SO4)	108	112	110	110	115
Chloride (CL)	260	253	270	270	251
Fluoride (F)	11	10.2	10.5	10.5	11.6
Boron (B)	11	10.7	11	7.8	---
Lithium (Li)	2.7	2.6	2.6	2.7	2.6
Iron (Fe)	---	0.23	---	---	0.23
Mercury (Hg)	---	0.0016	---	---	0.0023
Lead (Pb)	---	0.003	---	---	<0.05
Arsenic (As)	---	0.95	---	---	1.47
Cadmium (Cd)	---	<0.002	---	---	<0.13
Titanium (Ti)	---	<1.8	---	---	<0.25
Aluminum (Al)	---	<1.0	---	---	<1.28
Strontium (St)	---	---	---	---	0.22
pH	---	6.1	---	---	6.08
Total Dissolved Gases/c/	1015	1380	1120	840	---
Noncondensable Gases	Parts Per Million by Weight (ppm/w)				
Hydrogen Sulfide (H2S)	4.5	3.0	7.5	1.6	7.0
Ammonia (NH3)	2.5	3.0	4.0	1.8	0.3
Carbon Dioxide aq. (CO2)	1003	1370	1095	821	832
Hydrogen (H2)	0.1	0.1	0.4	0.4	---
Argon (Ar)	0.3	---	0.3	0.1	0.02
Nitrogen (N2)	3	3	10.0	12.0	1.5
Methane (CH4)	0.9	0.5	0.9	0.8	---

/a/ Farrar, C.D., et al, 1986.
/b/ Mesquite Group, Inc., 1986.
/c/ The Ben Holt Company, 1986.

SOURCE: PLES I Final EIR.

close agreement between data from the producing reservoir and from surface springs. A preliminary analysis of fluid from the Shady Rest well also indicates a composition very similar to that of the Casa Diablo wells, but with a far higher calcium concentration, possibly due to the abundant calcium-rich deposits in fractures observed in the core samples. Differences in fluid chemistry of surface hydrothermal features eastward of Casa Diablo have been explained by a combination of boiling of geothermal fluids and mixing with water of meteoric composition (Sorey, M.L., 1987). There are exceptions: for example, the ionic composition of fluids from the hatchery area well, CW-2, requires mixing and boiling fractions that are different from the other wells to account for its ionic composition.

3.1.4.5 Shallow Groundwater Use at Casa Diablo

There is one well at MP I capable of producing 50 gpm. It is used to supply on average 3,000 gallons per month for sanitary facilities and 500 gallons per month for irrigation. Irrigation use would be concentrated in the period May to October.

3.2 BIOLOGICAL ENVIRONMENT

The climate, altitude, and vegetation of the proposed goethermal project area include two distinctive life zones common to the eastern Sierra Nevada region: Upper Sonoran zone (at lower altitudes) and Transition zone (at upper altitudes). Each of the life zones contains distinctive plant communities which provide characteristic habitat for wildlife species.

A site-specific biological inventory and assessment of the Casa Diablo Hot Springs area and vicinity (the survey area outlined in bold on Figure 3-5) was conducted during the last quarter of 1986 (Taylor and Buckberg, 1986). The 630-acre survey area includes the proposed and alternative sites. A rare plant survey was done in the same area during June 1988 (Taylor and Clifton, 1988). Except where noted, the following site-specific information is from these biological survey reports. Both reports are included in Appendix D.

3.2.1 VEGETATION

Both mountain and desert plants characterize the flora located in the Casa Diablo Hot Springs area. More than 90 species of vascular plants were observed within the survey area during the surveys.

3.2.1.1 Plant Communities

Two principal habitat types were found in the survey area: (1) forest/woodland vegetation with Jeffrey pine (Pinus jeffreyi) and pinyon pine (Pinus monophylla) dominating; and (2) shrub vegetation with sagebrush (Artemisia tridentata ssp. vaseyana) dominating. However, ten different habitat types were observed and mapped within the survey area (see Figure 3-5). The habitat types identified within the survey area are as follows:

(a) Jeffrey Pine Forest

This habitat type is moderately dense (30-60% canopy cover) forest stand type, with a single overstory dominant, Jeffrey pine, that covers much of the survey area. Most of the stands are young (less than 80 years old). The understory in this forest consists of a dense to moderately open shrub layer, mostly sagebrush, bitterbrush, tobacco bush and low grass cover.

(b) Jeffrey Pine - Pinyon Pine Woodland

This habitat type consists of a successional stage forest and is intermediate in composition and structure with Jeffrey pine becoming established within Pinyon-Juniper Woodland. Jeffrey pine will eventually dominate unless subsequent disturbance, such as wildfire, occurs.

(c) Pinyon - Juniper Woodland

This woodland, with 20 to 40% canopy cover, is located on the steep slopes on the eastern portion of the Survey area. The understory in this woodland is similar to the Jeffrey Pine Forest but with greater abundance of rabbit brush and a variety of forbs and grasses. Canopy cover is generally less than 35 feet.

(d) Sagebrush Scrub

Stands of sagebrush scrub habitat cover the southwestern portion of the Survey area and a substantial portion (approximately three-fourths) of the proposed geothermal project area. Shrub cover averages about 30 to 50%. Other shrubs in this habitat include bitterbrush, rabbitbrush, horsebush and sulfur-flower, with moderate cover of cheatgrass. Canopy height ranges from two to four feet. A diverse assemblage of annual herbs could also be present in this area during years with good spring rains.

(e) Black Sagebrush Scrub

Although this scrub type is relatively uncommon in the vicinity of the survey area, several patches of black sagebrush (Artemisia nova) scrub do occur on basaltic rocks in the extreme southwestern portion of the site. Canopy cover and associated flora in this community is similar to sagebrush scrub, but canopy height is much lower, averaging less than two feet.

(f) Rhyolite Buckwheat Scrub

This distinct habitat is restricted to present, or former, thermally affected soils and is essentially limited to the region. Scrub cover is low, with large clumps of Rhyolite Buckwheat predominant. Associated herbs include Pussy-paws, locoweed and cheatgrass.

(g) Thermal Marsh

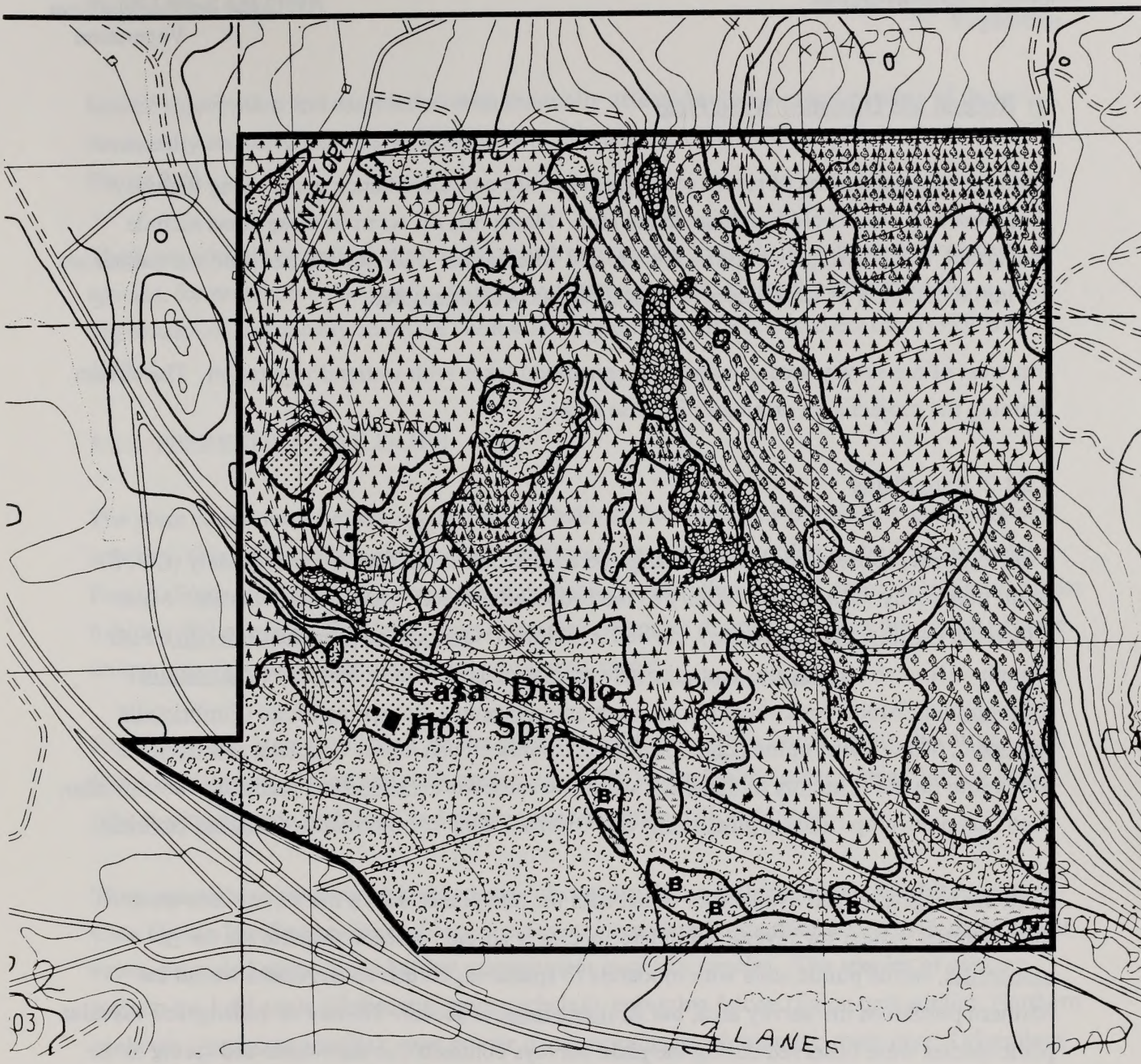
This marsh community is composed of sedges, rushes and grasses and is found around many of the thermal springs in the Mono Basin, Long Valley, and Owens Valley region. Height of the canopy is less than two feet, but cover is dense except where excessive evaporite deposits, or open water, limit vegetation.

(h) Yellow Willow Riparian

This vegetation type is composed of yellow willow, sandbar willow, Great Basin wild rose, and a lush and diverse herbaceous understory. This plant community occurs only in a small area near the southeastern corner of the survey area, along Mammoth Creek. At the time of the survey most of the understory species were dormant or so heavily grazed that identification of species was difficult.

(i) Nebraska Sedge Meadow

A large wet meadow exists near the southern boundary of the survey area. Vegetation of the meadow is dominated by Nebraska sedge, with Great Basin iris and rush as important condominants.



Jeffrey Pine Forest
Jeffrey Pine-Pinyon Pine Forest
Pinyon-Juniper Woodland
Sagebrush Scrub
Black Sagebrush Scrub
Project Area

Rhyolite Buckwheat Scrub *
Willow Riparian Thicket
Nebraska Sedge Meadow
Thermal Marsh *
Disturbed
* Botanically Sensitive Areas

0 850 1700
FEET

SOURCE: Biosystems Analysis Inc., Jan. 1987

FIGURE: 3-5
Habitat Type Map

(j) Ruderal and Disturbed Weed Field

Sparsely vegetated areas of recent or frequent surface soil disturbance occur along highway shoulders and sites of old buildings in the area. Plants that do occur in these areas include cheatgrass, dandelion, peppergrass, and crested wheatgrass. Floristic elements of this habitat are the initial colonists of sites where revegetation has been attempted.

Just west of the survey area is a group of ephemeral lakes with wetland vegetation. The stream draining the project area originates in these lakes.

3.2.1.2 Rare Plants

Twelve plants, considered rare or endangered by the California Native Plant Society (CNPS), could potentially occur in the vicinity of the proposed project. These plants include: Mono milkvetch (Astragalus monoensis), Howell's locoweed (Astragalus johannis-howellii), Fish Slough milkvetch (Astragalus lentiginosus var. piscensis), Nevada centuray (Centaurium namophilum), Mono buckwheat (Eriogonum ampullaceum), hot spring sedge (Fimbristylis spadicea), Mono Lake lupine (Lupinus duranii), pumice bush lupine (Lupinus montigenus), Mammoth lupine (Lupinus sublanatus), scalloped lousewort (Pedicularis crenulata var. candida), Pine City stonecrop (Sedum pinetorum) and Owens Valley checkermallow (Silacea covillei).

Both the geography and availability of habitats for rare plants within the survey area are such that potential habitat for several candidate species is absent. Habitat suitable for the A. monoensis, sterile pumic soils with moderate to sparse sagebrush cover, exists within the northern portion of the survey area, but A. monoensis, is absent. No rare or endangered vascular plant species were observed during the plant surveys conducted in the winter and spring in the proposed project area (Taylor and Buckberg, 1986, and Taylor and Clifton, 1988).

Both surveys are included in Appendix D. Earlier thorough botanical investigations and botanical collecting trips at the Casa Diablo Hot Springs found no rare or endangered species there.

3.2.1.3 Botanically Sensitive Areas

Two habitat types occurring in the survey area, thermal marsh and rhyolite buckwheat scrub, are considered botanically sensitive (Holland, 1986). Both habitat types are sensitive owing to their

limited distribution and association with thermally affected soils. Several patches of these botanically sensitive habitats were found within federal geothermal lease CA-11667 (see Figure 3-5).

There are no state or federal regulations which provide for listing a habitat, as distinct from a species, for protection. Generally, federal and state agencies informally recognize the importance of botanically sensitive habitat areas and make efforts to protect them (Holland, 1988).

3.2.2 TERRESTRIAL WILDLIFE

The plant communities of the region provide habitats for a diversity of resident and migratory wildlife. Over 400 species of terrestrial vertebrates have been recorded in the Inyo National Forest. Some species are restricted to single habits, while other species range over almost all the habitats of the region. Similarly, major streams and spring drainage areas in the region provide unique aquatic habitats for native and introduced species.

Pine forest and sagebrush shrub are the principal wildlife habitats found within the survey area. Some meadow vegetation and rock outcrops are also located in the survey area. Jeffrey and pinyon pine provide both food and nesting sites for mammals and birds.

There are eight migrant or resident species of concern that could potentially inhabit or use the Casa Diablo Hot Springs area. These species are considered important due to their recreational value, protected status, or as habitat management indicator species. The species of concern include the bald eagle (Haliaeetus leucocephalus); peregrine falcon (Falco peregrinus); Northern goshawk (Accipiter gentilis); sage grouse (Centrocercus urophasianus); mule deer (Odocoileus hemionus); and three cavity nesting bird species, the pygmy nuthatch (Sitta pygmaea), Williamson's sapsucker (Sphyrapicus thyroideus), and hairy woodpecker (Picoides villosus). In addition, an important riparian indicator species, the yellow warbler (Dendroica petechia), may occupy a small section of riparian habitat near the southeast corner of the survey area approximately one-half mile southeast of the project site.

(a) Bald Eagle

This bird species is listed as endangered by the U.S. Fish and Wildlife Service and Fish and Game. Bald eagles use the Owens River Valley during the winter migration. Eagles perch,

roost, and hunt within these areas. While most foraging occurs along the river, there is some limited use of dry land/sagebrush habitat. Roost sites, typically in large saw timber or old growth stands, are a primary component of the eagle's winter range (November - April). A single eagle was observed in flight approximately one mile away from the survey area during the Taylor and Buckberg field survey. There are no roosting or feeding sites within the survey area or in the immediate vicinity.

(b) Peregrine Falcon

This bird species is listed as endangered by the U. S. Fish and Wildlife Service and Fish and Game. Reintroduced peregrine falcons may use the survey area for occasional foraging and as dispersal routes for juveniles. However, the lack of open water and the relative scarcity of waterfowl, columbids, and other avian prey species favored by the peregrine falcon decrease the potential that the survey area is used for foraging. The survey area is also poorly suited for peregrine falcon nesting habitat.

(c) Northern Goshawk

This fully protected species, regarded as a sensitive species by the Forest Service, is a bird of mature forests characterized by relatively closed overstory and a dense understory of seedlings of non-uniform height. It prefers mid- to high-elevation coniferous forests. The Jeffrey pine forest within the survey area is relatively young with only sparse understory of occasional pinyon pine and is judged to be largely unsuitable for goshawks. However, an occasional goshawk may forage within the survey area given that it can feed in forest, meadows, and range types.

(d) Sage Grouse

These large upland game birds are year round residents in the Mammoth Lakes region. Sage grouse populations in the area severely declined approximately ten years ago. In 1982, the sage grouse hunting season was closed and, since that time, the local grouse population has approximately doubled. Sage grouse are dependent on sagebrush stands for nesting, thermal cover, hiding cover, and feeding during the fall and winter; and they are used as a management indicator species by the Forest Service for sagebrush plant communities. Wet meadows and other grassland habitats are used heavily for feeding during spring and summer when seeds, insects, and succulent vegetation area available. The southern portion of the survey area provides limited amounts of moderately suitable sage grouse habitat (see Figure 3-5).

Grouse use large open areas in the sagebrush for strutting grounds (leks) during the breeding season. Leks are traditional sites in which grouse congregate and where the males perform courting displays. After mating, females disperse to nest and raise the young. Leks are an important part of the habitat needed by grouse. Major areas of sage grouse leks are in the Lake Crowley and Bodie areas. There are no leks in the immediate vicinity of the survey area.

(e) Cavity Nesting Species

The Williamson's sapsucker, pygmy nuthatch, and hairy woodpecker are fully protected bird species. Parameters for optimum habitat were developed for each of the species by McCarthy and Hargis (1984). Owing to the lack of lodgepole pine cover type and other parameters the habitat in the Casa Diablo survey area is believed inadequate for Williamson's sapsucker. The forest habitat within the survey area meets most of the habitat parameters for the pygmy nuthatch and hairy woodpecker except for optimum snag density. Thus, the survey area was characterized as of intermediate importance for these species.

(f) Yellow Warbler

The yellow warbler is used by the Forest Service as a management indicator species for riparian habitats. The Yellow warbler is dependent upon riparian communities typical of that found along Mammoth Creek. A short segment (about 500 feet) of Mammoth Creek, and associated riparian community, winds through the southeastern corner of the survey area, approximately one-half mile southeast, and downstream, of the proposed project area. However, there is no riparian habitat within, or adjacent to, the proposed project site.

(g) Mule Deer

This migratory game species is recreationally important to the region and is of special interest because of the statewide decline in mule deer numbers over the past 20 to 30 years (Forest Service, 1986). Three herds (Casa Diablo, Sherwin, and Buttermilk, as defined by Fish and Game) are known to occupy the Mammoth Lakes area; each is addressed in a management plan jointly adopted by the BLM, Inyo National Forest, and California Department of Fish and Game. Seasonal migratory movements are tied to weather patterns and food resources. The breeding biology of the deer is adapted to their movements, and the spring and fall migration corridors, and both summer and winter range, are vital links in the life histories of these herds.

A relatively rapid winter migration typically begins after the first major snowfall. However, the 1986 fall migratory movement was atypical owing to the mild onset of winter, and the herds migrated more leisurely than usual (Kucera, T., 1987a). Most of the Casa Diablo herd, which numbers about 1,500 deer, is believed to migrate north of the survey area and winter east of the Owens River, from Casa Diablo Mountain north and east to the California-Nevada border. Truman Meadow, Marble Creek, and a narrow strip of habitat between Black Rock Mine and Casa Diablo Mountain are the major wintering areas for this herd. The Sherwin Grade herd, which numbers an estimated 2,300 to 2,400 animals, winters in the area west of U.S. Highway 395, north of Pine Creek, generally south of Sherwin and Swall Meadows, and east of Wheeler Ridge. The Buttermilk herd winters near the Sherwin Grade herd and numbers about 3,000 (Thomas, R.D., 1986a and 1986b).

With the onset of spring, deer from both the herds begin a leisurely migration west and up the Sierra slope toward summer range. Generally migration occurs between mid-April and mid-June. The routes, defined by the rugged topography of the Sierra, are traditional: young deer learn the routes from their parents and other members of the herd. Solitude Canyon, Mammoth Pass, and Duck Pass are the key migration routes over the Sierra crest used to reach the summer range. To reach the passes, deer from the Sherwin herd move north from the wintering grounds, generally staying west of U.S. Highway 395 and east of the base of the Sierra. Some deer from the Sherwin herd are thought to cross U.S. Highway 395 and use the habitats around Casa Diablo Hot Springs, and some deer from the Casa Diablo herd are thought to cross the survey area as they migrate upslope toward the Sierran summer range.

Habitat within the survey area is of moderate value for mule deer. Thermal cover is also of moderate value because crown closure is, in general, less than 75%; however, relative to the valley floor of low sagebrush and grassland habitat, portions of the survey area provide good thermal cover and would likely be favored in times of thermal stress.

Mule deer have been observed within the survey area and evidence of mule deer in the Casa Diablo Hot Springs area were observed during the Taylor and Buckberg survey (see Figure 3-6). Results of spring, summer, and fall 1987 track surveys indicate a dispersed pattern of deer activity in and movement through the project area (Kucera, 1987). Two survey reports together provide an estimate of relative deer numbers and areas of concentration. The reports are provided as Appendix E. The number of deer using the 630-acre survey area during the spring migration period was estimated to be approximately 70 animals (Kucera, T.E., 1987b). Deer use of the study area during the summer was moderate, perhaps six to ten animals. The normal fall

migration typically occurs between mid-October and mid-November. The fall 1987 migration was probably atypical due to the lack of a major fall storm, the event which normally triggers the migration to winter range, so even crude estimates of the number of animals passing through on a fall migration could not be performed. This deer movement does not appear to be concentrated in any localized portion of the survey area, but is dispersed throughout it.

3.2.3 AQUATIC RESOURCES

3.2.3.1 Aquatic Habitats and Species of Concern

The major waters in the project area consist of thermal springs, cold springs, and surface streams. No perennial streams are found within the project area itself, but the southwestern portion is crossed by a small intermittent stream approximately two to six feet wide which drains the site. Because of the stream's size, chemical and thermal characteristics, and its ephemeral nature, no riparian vegetation is connected with the stream, and no salmonid aquatic species are believed to exist within the stream.

The project area is within the watershed of Mammoth Creek, a perennial stream, located approximately one-half mile southeast of the project site. Mammoth Creek is fed by rainfall, snowmelt and springs and flows north and east to its confluence with Hot Creek. Water temperatures in Mammoth Creek range from 10° to 14°C (50° to 57°C) (WESTEC Services, Inc., 1986). Water quality is influenced by construction and waste inputs from human activity near the city of Mammoth Lakes and from livestock grazing along its streambanks.

Approximately three miles east of the project site, three spring groups form the headwaters of Hot Creek. Both thermal and nonthermal waters are believed to contribute to spring discharge (see Section 3.1.4, Hydrology). Average spring temperatures range from 11° to 16°C (52° to 61°F) (WESTEC Services, Inc., 1986). Hot Creek Hatchery is situated immediately downstream of the springs and takes advantage of this water source in its hatchery operations. A fourth hot springs enters into Hot Creek below the hatchery facility. Downstream from this point Mammoth Creek is called Hot Creek. The creek, as it flows east and north towards the Owens River, gradually increases in temperature as inflow from hot springs within the stream channel and along its bank augments the stream flow and raises its temperature. Aquatic invertebrates in Mammoth Creek are dominated by caddisflies, stoneflies, and mayflies. Hot Creek invertebrate fauna consists primarily of amphipods and caddisflies (Forest Service, 1986). Studies are underway which would describe various endemic snail species dependent upon springs with

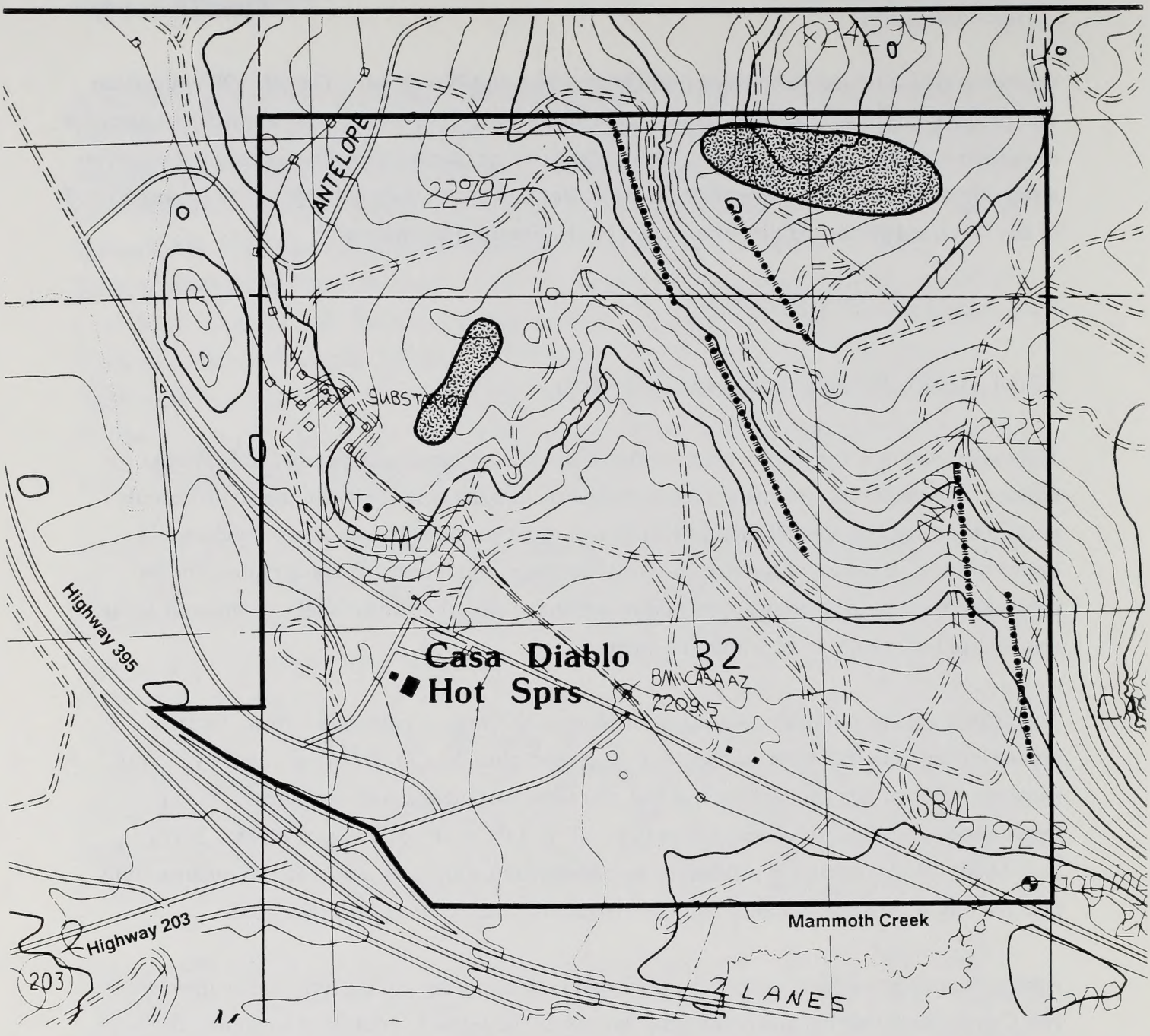


FIGURE 3-6
Deer Observations

minor thermal components (Wong, 1988). There is no complete survey of aquatic invertebrates for the project vicinity, although fragmentary information is available from individual collectors.

One recent study, which surveyed for tiny, gill-breathing spring snails in the Mono, Adobe, Long, Benton, and Owens Valleys as well as the eastern Sierra Nevada from Little Lake through Indian Wells Valley, located one species of spring snail, Stryonia protea, in a relatively pristine area along Hot Creek in Long Valley (Hershler, 1987).

Both Mammoth and Hot Creeks support naturally spawning populations of rainbow and brown trout. Fish and Game Department stocks trout in Mammoth Creek upstream of Highway 395. Hot Creek is one of only two state-classified wild trout fisheries in the Inyo National Forest (Forest Service, 1988). The brown trout in Hot Creek upstream from the Hot Creek interpretive site exhibit exceptional growth which is attributed to geothermal warming of the stream water. The slightly elevated temperatures increase primary and secondary productivity, in the form of aquatic plants and numerous insects, as well as raising the metabolic rates of resident trout. Based on current knowledge of trout physiology, rainbow trout will survive temperatures of 32°F to 82°F, with optimum temperatures for growth and completion of most life history stages at 55°F to 70°F (Moyle, P.B., 1976). Temperatures of 45°F to 66°F are optimum for rapid growth of brown trout, with preference of temperatures on the upper end of this range. Brown trout are able to withstand short exposures to temperatures in excess of 81°F.

Below the confluence of Mammoth Creek and Hot Creek, California fishing regulations allow only artificial dry flies on barbless hooks to be used, and any fish caught must be released unharmed. These restrictions are strictly enforced and apply through the Hot Creek Ranch property, a private, commercially operated fishing facility, and downstream to the Owens River.

The Hot Creek headwater springs also provide a unique habitat for the state and federally listed endangered Owens tui chub, (Gila bicolor synderi). The Owens tui chub was formerly abundant throughout the Owens River drainage and represents one of the four fish species native to the areas. The distribution of this subspecies of tui chub has been gradually restricted by the development of dams, subsequent water withdrawals within the Owens River watershed, and competition with non-native species. It now exists in scattered refugia in the Owens River drainage area, specifically below Long Valley Dam and at the Headwater Springs of Hot Creek (Thomas, T., and R. Feldmeth, 1987). To date, the recovery plan for this fish has not been

adopted. However, a draft recovery plan is being used by the Fish and Wildlife Service and Fish and Game which includes preserving existing habitats and developing multiple new refugia for the species.

The U.S. Fish and Wildlife Service and Fish and Game are concerned that current flows and water quality characteristics at the headwater springs of Hot Creek are maintained.

A biological assessment for review and approval by the U.S. Fish and Wildlife Service was prepared in compliance with federal regulations for implementing Section 7 of the Endangered Species Act [40 CFR Part 402.12(f)]. The report concluded that it is reasonable to suggest that the Owens tui chub population in the Hot Creek headwater springs has adapted physiologically to the almost constant thermal and mineral regime of that particular habitat. However, data on thermal and salinity tolerance recently obtained from the Mohave tui chub suggest the species can adapt to modified environments. Additionally, Owens tui chub taken from Hot Creek headwater springs were successfully transported to the Owens Valley Native Fish Sanctuary where they have been able to tolerate a seasonal temperature regime that ranges from 10° to 26°C (50° to 79°F) (Thomas, T., and Feldmeth, R., 1987).

3.2.3.2 Hot Creek Hatchery

The Hot Creek Hatchery is managed by the Fish and Game. The Hot Creek Hatchery is one of the oldest fish hatcheries in the state. It was brought into operation in the 1930's and operations include production of trout eggs for other state hatcheries; rearing of fingerlings and catchable trout for stocking in Sierran streams, lakes, and reservoirs; and production of brood stock for future egg production. Approximately 22 million eggs are produced per year from this hatchery, about 1.25 million fingerlings are taken to other Fish and Game regions for stocking, and at least 700,000 catchable trout (nine to ten inches) are stocked in Alpine, Madera, and Mono County waters (Eichmann, J., 1987a).

The operation of Hot Creek Hatchery is dependent on the predictable temperature and reliable flows of the several springs which supply the facility. Two sets of springs feed the production, or rearing, ponds. The upper springs, AB springs ranged from 59.5°F to 64.5°F and CD springs ranged from 55°F to 60°F during the period 1976 to 1987. Fish and Game states that an average

decrease of greater than two degrees Fahrenheit from the present temperature regime would slow fish growth and result in higher costs to the hatchery program because of the additional feed needed and the larger number of ponds and water which would be required to hold the fish for a longer period of time until they reached suitable planting size (Eichmann, J.L., 1987c).

The broodstock facilities are fed by smaller springs at the lower (east) end of the hatchery grounds. These springs are probably the most critical to the hatchery program as they supply water to the egg producing facilities, and fish within these ponds are the most sensitive to temperature variation. Temperatures of the springs feeding the Hatchery 1 broodstock pond complex, temperatures ranged from 52.5°F to 56°F. At Hatchery 2-3 brood stock pond complex, temperatures ranged from 50.8°F to 54.2°F. Within these complexes, up to seven strains of wild and domestic cutthroat, rainbow, brook, and golden trout are spawned on a staggered schedule throughout the year. Under natural conditions, trout spawn in the spring; however, the Coleman strain of rainbow trout is of particular importance because it spawns after the Hot Creek strain (e.g., November through January versus July through September) and before trout raised at other facilities, thus enabling the hatchery to plant trout year-round. The Coleman strain accounts for about 40% of the eggs and about 20% of fish raised at the hatchery (Boone, 1988).

In order to produce 20 million eggs annually, trout must be held for at least six months before spawning in waters not exceeding 56°F, but preferably not above 54°F. A temperature increase to 57°F would result in a decrease in fertility; whereas, a temperature 58°F would severely impact the hatchery operation (Eichmann, J.L., 1987b). A reduction of 2°F in the present temperature range would delay spawning until spring due to the increased time necessary for egg maturation which would, for all practical purpose, eliminate the Coleman and Hot Creek strains and severely impact the hatchery's statewide trout planting program. However, because the lower range temperature of these springs is equal to non-thermal springs in the area, removal of the thermal component would not result in a reduction below the current lower range temperature of these springs.

3.3. SOCIAL ENVIRONMENT

3.3.1 CULTURAL RESOURCES

3.3.1.1 Cultural Setting

Results from numerous archaeological investigations suggest the Owens-Long Valley region was once inhabited and used, for subsistence purposes, by numerous groups of hunter-gatherers over a period of 8,000 to 9,000 years. The latest peoples to inhabit the region were Numic-speaking groups. Ethnographic evidence indicates that Numic-speaking Mono Lake Paiute and Owens Valley Paiute territories bordered, and perhaps resided in, Long Valley. Linguistic evidence also indicates that Numic-speaking western Sierra Mono and Penutian-speaking central and southern Sierra Miwok may have inhabited the general Long Valley area at one time. Estimates of previous northern Paiute populations in Owens Valley range from 1,000 to 2,000 and it is believed districts of Paiutes may have been located as close as 37 km to the Casa Diablo Hot Springs (Hall, M.C., 1986).

Prehistoric cultural remains frequently found in the eastern Sierras include flaked stone debitage, particularly fragments of ground stone tools. Also pieces of pottery and ceramic vessles and organic refuse often characterize these cultural remains. Many of the artifactual remains suggest significant commerce between the various prehistoric hunter-gatherer groups but numerous questions regarding various aspects of the cultural systems belonging to these groups remain.

3.3.1.2 Native American Values

Any site which Native Americans consider sacred is very sensitive to impacts. The types of places deemed sacred include sources of residual sacred power, creation sites, and other sites named after or closely identified with powerful sacred persons or happenings. These are usually mountain tops, caves, rock shelters, springs (especially hot or mineral), or rock art sites. Also judged to be sensitive to impact are sites with ritual association. In addition to the types of sites just mentioned, ritual sites may also include burial and cremation sites, places used for prayer and meditation, for healing, and for training shamans, and places where plants, animals or

minerals for sacred use are gathered. Sites named in traditional songs and other literature and sites to which people came to trade, visit, recreate, or process foods also may be considered sacred. In addition, Native American trails, the sites of villages (with those most recent being more sacred), traditional food collection areas, and animal species whose ecosystems are endangered are of special concern to Native Americans (Bean, L. and S. Vane, 1987).

Springs and other sources of water, especially hot springs or springs where healing rites are performed, are especially sensitive, having sacred connotations. It is considered that hot springs are connected underground with sources of power, which can be dangerous, but also can be tapped for healing purposes (Bean, L. and S. Vane, 1987).

Some hot springs and associated vegetation and soils within the Long Valley area continue to be utilized for traditional Native American cultural and religious values (Reynolds, L., 1987). Contemporary Native American concerns to impact on the previously mentioned areas are highest in areas which they presently use, or which have a direct historical connection with living people (Bean, L. and S. Vane, 1987). Thus, Casa Diablo Geyser and other hot springs and fumaroles in the project area could be considered important, although no sites near the proposed project have been identified as sacred by Native Americans.

3.3.1.3 Site-Specific Cultural Resources

Site-specific cultural resources surveys were conducted, in conformance with requirements of the United States Forest Service, on Federal lease CA-11667 which contains the proposed project area (Hall, M.C. 1986). The following discussion summarizes the survey results with regard to cultural resources identified within lease CA-11667 during the three referenced cultural resources investigations.

(a) Cultural Resource Site-1

The initial cultural resources surveys discovered a single, previously unreported, Cultural Resource Site-1 southeast of the MP I power plant (Hall, M.C., 1986). The survey unveiled a low density scatter of obsidian flaked stone debitage (two to four pieces per square meter) and two use-modified obsidian flakes. No evidence of a subsurface cultural deposit was observed at Cultural Resource Site-1. The site was tested for significance and eligibility for inclusion on the National Register of Historic Places by a four-person team of archaeologists (Hall, M.C., 1986).

A 900-square meter grid (30 x 30 meter provenance grid) subdivided into four contiguous 15 x 15 meter units each comprised of nine separate "quads" was established. Excavation of four arbitrary 1 x 1 meter units revealed that the majority of the cultural deposits at Cultural Resource Site-1 are surficial. During this testing program 185 items were collected, including 171 unmodified pieces of flaked stone debitage (168 consisting of obsidian flakes), eight obsidian edge-modified flakes, two obsidian biface fragments, two obsidian flake tools, a large mammal bone fragment, and a single piece of ochre. Eighty-six of these items were discovered on the surface, 53 in two 5 x 5 x 0.2 meter surface scrapes and 46 in the four 1 x 1 meter excavation units. All but 17 of the 171 unmodified pieces of flaked stone debitage were attributed to the local Casa Diablo source although it is possible some, but not all, of these 17 flakes also originated from the Casa Diablo source.

Dating done by hydration analysis of 21 obsidian artifacts recovered during data recovery suggest Cultural Resources Site-1 was occupied by humans between 9,500 and 250 years B.P., principally between two distinct periods, 3,400-3,100 B.P. and 1,900-100 B.P. These results are reported to indicate prehistoric cultural activity at the site during several brief occasions between the present and 11,000 years B.P. (Hall, M.C., 1986). This activity most likely consisted of stoneworking the obsidian nodules from the Casa Diablo obsidian source areas surrounding the site. These results and subsequent interpretations are consistent with the land-use activities of the hunter-gatherer populations known to have inhabited the Owens Valley and adjacent areas.

Five other cultural resources sites (not including 1) were also discovered on Federal lease CA-11667. Brief descriptions of each of these five sites are given below.

(b) Cultural Resource Site-3

This site may represent previously recorded archaeological location. This site consists of an approximately 20 x 20 meter scatter of obsidian flaked stone debitage at a surface density of approximately three flakes per square meter.

(c) Cultural Resource Site-5

This site may represent a previously recorded archaeological location. It consists of an approximately 30 x 85 meter scatter of obsidian flaked stone debitage at a surface density of approximately two to four flakes per square meter.

(d) Cultural Resource Site-6

This site consists of an approximately 20 x 37 meter scatter of obsidian flaked stone debitage at a surface density of approximately two flakes per square meter.

(e) Cultural Resource Site-10

This extensive "site complex" covering more than 250,000 square meters includes three previously recorded archaeological locations, which are connected by a low-density scatter of obsidian flaked stone debitage located on the lower slopes and flats beneath the rhyolite domes immediately east of Casa Diablo Hot Springs and north of Mammoth Creek. Prehistoric archaeological remains included obsidian flakes (surface density of approximately two or more flakes per square meter), several obsidian blank/biface production loci (including one locus where the obsidian flakes appear to have been struck from natural obsidian nodules) and a bedrock mortar locus. Historic remains included tin cans, bottle and metal automobile fragments, and various wood and rubber items.

(f) Cultural Resource Site-11

This extensive "site complex" covering more than 200,000 square meters includes four previously recorded archaeological locations. Obsidian flaked stone debitage (surface density of approximately two flakes per square meter) connect the previously recorded sites although numerous loci of high densities (up to 50 or more) or obsidian flakes also occur within Cultural Resource Site-11. Other prehistoric archaeological remains, such as obsidian tools, were also observed.

3.3.2 RANGE RESOURCES

The proposed project area is located within the Long Canyon Unit of the Hot Creek Grazing Allotment. This allotment is under permit to Miller and Wood and is administered by Inyo National Forest. On a unit-wide average, 6.1 acres of land are required to support one animal for one unit month's time, an animal unit month (AUM). Each AUM returns approximately $1.36 to the Federal Government. Approximately 37 animals graze the Long Canyon unit, generally between August 15th and August 25th, resulting in an AUM output for the entire unit of approximately 91 AUM's. Land within the project area is considered less suitable for grazing than the average land within the unit as a whole (Forest Service, 1988).

3.3.3 RECREATIONAL RESOURCES

The project area is three miles east of the Town of Mammoth Lakes, which has approximately 5,000 permanent residents. Located at the junction of the Great Basin and the Sierra Nevada Mountains, the beauty and recreational resources of the area have made Mammoth Lakes a popular resort. The nearby Mammoth Mountains Ski Area has become the largest in the country, attracting over 19,000 skiers at one time during peak ski season (Morse, M., 1987).

Summertime recreation uses in Mammoth Lakes are estimated to attract over 1.5 million visitor-days per year (Forest Service, 1988). Outdoor recreational activities include backpacking, camping, fishing, mountaineering, swimming, boating, and sightseeing. There are two campgrounds near the proposed project site. The Sherwin Creek Campground is 1.5 miles southwest of the site and Shady Rest Campground is three miles west of the site. There are approximately 32,700 visitor-days at Sherwin Creek and 91,200 visitors-days to Shady Rest annually (Lloyd, J., 1987).

Hot Creek Hatchery, known for developing a unique strain of rainbow trout, is three miles east of the site at the headwaters of Hot Creek. These trout are spawned in the fall, and by the following spring their progeny have grown to approximately six inches in length and area ready for stocking in local streams and lakes. Hot Creek Hatchery raises over 700,000 catchable size trout and 1.25 million fingerling trout for stocking in the Inyo-Mono area annually (Eichmann J., 1987a). Immediately east of the hatchery, Hot Creek Ranch offers trophy trout fishing from May 1st to October 30th. Nine to eleven cabins are available at the ranch each season with

five-person occupancy. During the fishing season the ranch averages 15,000 to 20,000 visitor-days (Millikan, G., 1987). The Hot Creek recreational area also contains Hot Creek Gorge, where hot springs emerge in Hot Creek. It is a favorite recreational spot for visitors to the Mammoth area and is open to the public throughout the year from sunrise to sunset. All totaled, Hot Creek averages 95,000 recreational- visitor-days a year (Lloyd, J., 1987).

Dispersed recreational activities in the project vicinity include camping, shooting, wood collecting, jogging, bicycling, snowmobiling, and deer hunting. The area bounded by Hot Creek, Highway 395, Route 203, the Sherwin Creek recreational area, and Convict Lake was visited by approximately 3,000 game hunters during the 1986 season (Morse, M., 1987). No developed recreational facilities are located within the project site. However, Antelope Springs Road and scenic Highway 395 and Route 203 are near the project site and serve as the main access roads for the various dispersed recreational activities in the Little Antelope Valley located about four miles northeast of the project and alternate sites.

3.3.4 TIMBER RESOURCES

The proposed project site and the alternate power plant site are located on the southern edge of an area within the Inyo National Forest which is managed for commercial timber production. Species which are managed for timber harvest include Jeffrey pine, red fir, white fir, western white pine, and lodge pole pine. There are scattered Jeffrey pine and pinyon pine on the western portion of the project site and a denser stand of Jeffery pine and pinyon pine on the eastern end of the proposed project location. Some Jeffrey pine on the eastern end of the project site may have commercial value; however, the proposed project site is not located on land currently managed for commercial timber production. Merchantable timber available at the site is sparse and of poor quality. Young growth is targeted for transplanting, so the Forest Service determined that timber should be valued as fuel wood and estimated the volume at approximately 3.6 cords.

3.3.5 TRANSPORTATION AND SITE ACCESS

The proposed project area is located at the intersection of Hot Springs Road (Mono County Road No. 346A) and California State Route 203. It is immediately accessible from the Mammoth Lakes offramp (Route 203) from existing U.S. Highway 395 (Highway 395) (see Figure 2-1).

The portion of Highway 395 in the project area is a four-lane divided highway with seasonally heavy traffic, particularly during the winter ski season. Highway 395 is the major north-south highway along the eastern Sierras. California State Route 203 is currently a two-lane paved road east of Highway 395 and a four-lane divided highway west of Highway 395 which serves as the principal access to the Town of Mammoth Lakes from Highway 395. Traffic on route 203 is typically light except during the winter ski season. Substantially less traffic utilizes the small portion of Route 203 east of Highway 395 than uses the part west of Highway 395.

Hot Springs Road is a very lightly travelled, two-laned, paved road maintained by Mono County which crosses the proposed project site. Hot Springs Road intersects the unpaved Forest Road 3S05, maintained by the Inyo National Forest, approximately one-half mile northwest of the proposed power plant site. Antelope Springs Road provides access to dispersed recreation in the Little Antelope Valley area. A one-laned paved road (Casa Diablo Cut Off Road) is immediately west and southwest of the existing MP I power plant and together with Hot Springs Road and Route 203 circumscribes the proposed production wellfield.

The proposed project and the alternative location would make use of existing unpaved access roads within the Inyo National Forest. The alternate power plant site would be reached by traveling Hot Springs Road to the unpaved substation road which accesses the alternate site (see Figure 2-6).

3.3.6 VISUAL RESOURCES

3.3.6.1 Existing Programs, Plans and Policies for Managing Visual Resources

(a) BLM Policies

Geothermal Resource Operational Order No. 4 (U.S. Geological Survey, Conservation Division, 1976) requires lessees of geothermal resource areas under federal jurisdiction to reduce the visual impact of geothermal development through careful site selection and through sensitive design and construction of facilities.

(b) Forest Service Plans and Policies

The Forest Service's Environmental Concern Maps in the environmental analysis for the Geothermal Lease Sale Area #1, Inyo National Forest, identify the proposed project site, as Visual Resource Constraint Level 2. This constraint level indicates that where surface occupancy should be limited to controlled off-road vehicle use, and surface occupancy for geothermal activities should be excluded unless surface management concerns can be mitigated.

Furthermore, the Land and Resource Management Plan, Inyo National Forest (Forest Service, 1988) designates visual quality objective for the project site for "Retention." Management policy for an area designated for Retention is to manage the area so that its natural appearance is maintained. The Management Area Directions for visual resources include "mitigate the visual impacts of existing major uses in the area seen from U.S. 395 and State Route 203 east of the town." The visual resource policies in the Management plan were developed using the Forest Service's Visual Management System (VMS), a system developed as part of its National Forest Landscape Management program (Forest Service, 1974). It should be recognized that the Forest Service Visual Quality Objectives are management guidelines and not regulatory standards and can be changed through an environmental analysis process. The VMS applies to all management activities on National Forest lands.

The intent of the VMS is to identify the visual character of the landscape, catalog its visual quality, and analyze in advance the visual effects of resource management actions.

The VMS methodology consists of: (1) identifying the character type and inventorying variety classes of the landscape and its subdivisions; (2) preparing a Sensitivity Level inventory which addresses both visibility and relative number of viewers; and (3) using the Variety Class and Sensitivity Level inventories to identify Visual Quality Objectives (VQO) which define acceptable degrees of alteration of the natural landscape. The VQOs for the Casa Diablo vicinity are shown in Figure 3-7.

3.3.6.2 Sensitive Receptors

All people exposed to the landscape proposed for modification are considered to be sensitive receptors. Expectations and aesthetic concern varies with the viewer, so that the response of a

particular viewer is highly subjective. In general, the Forest Service considers recreationists to be the major viewing population, but for purposes of analyzing visual impacts in the project area, the Forest Service does not distinguish between first-time viewers and repeat viewers or resident and non-resident viewers (Rickford, E. B., 1987).

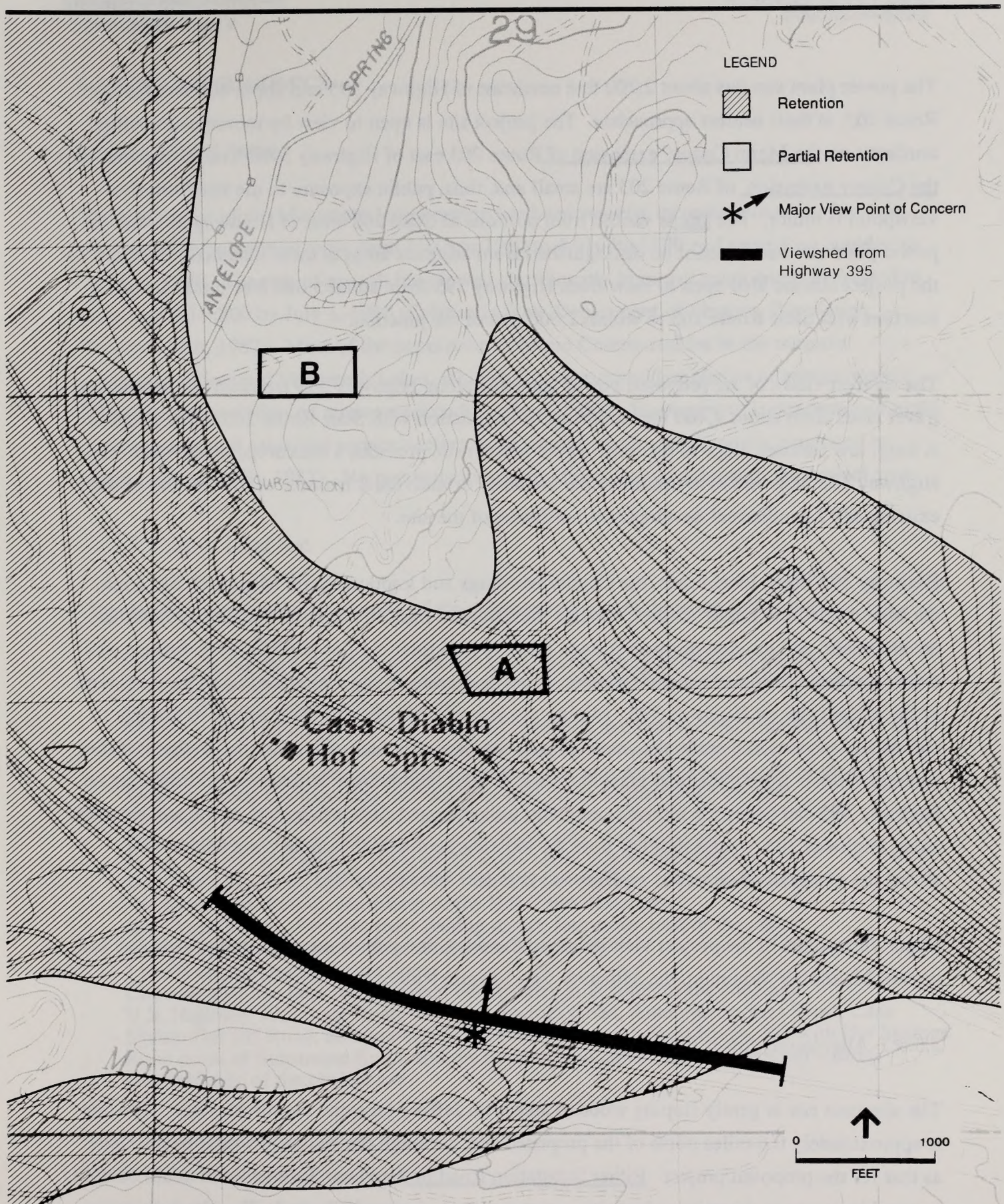
3.3.6.3 Regional Setting

The visual character of the project vicinity is dramatic and is one of the primary attractions for visitors to the Mammoth Lakes area. The project site lies on the edge of Long Valley on the eastern side of the Sierra Nevada. The snow-capped peaks of the Sierra Nevada, several of them over 14,000 feet in elevation, rise abruptly to the west from a base elevation of about 7,500 feet. The rugged topography and the young geology of the region provide several visual resources of particular scenic value, including Mammoth Mountain, Mammoth Rock, Crystal Crag, the Minarets, and Long Valley. Long Valley is a large, sparsely vegetated basin that drops away from Highway 395 to the east, affording sweeping vistas. Devil's Postpile National Monument, Ansel Adams Wilderness, and John Muir Wilderness are local natural areas with high-quality visual resources preserved for the enjoyment of the general public.

The vegetation and wildlife of the region contribute to its high visual quality. Overall, the variety of vegetation and topographic features is high with patches of pine forest and meadow, barren rock outcrops and avalanche slopes, chapparal and sagebrush and varied textures and colors. Low ridges and isolated hills break the view and create contained views of distinctive landscapes. Wildlife is abundant in the area and views of deer, hawks, eagles, rabbits, and other animals greatly enhance the aesthetic experience both for those pursuing recreational activities in the more isolated portions of the region, and for residents and visitors traveling local roads and highways. The water of streams, lakes, seeps, and snow is an attractive visual element common in landscapes visible from key viewpoints.

3.3.6.4 Proposed Project Site

The project site is a gently sloping area of primarily sagebrush scrub and scattered pine trees on the northeastern side of Highway 395 near the terminus of Route 203. Hot Springs Road provides access to geothermal development the projects in the Casa Diablo area. The existing geothermal development, MP I, is west of the project site.



A Proposed Site
B Alternate Site

SOURCE: U.S. Forest Service, 1987.

FIGURE 3-7
U.S. Forest Service Visual Management Objectives for the Casa Diablo Hot Springs Area

The power plant site lies about 2,200 feet northeast of Highway 395 and about 400 feet north of Route 203, at their nearest approaches. The project site is open to view by motorists traveling northeast on the Mono County extension of Route 203 east of Highway 395. Traffic volumes on the County extension of Route 203 are small and, thus, public exposure to the site from this viewpoint is minor. The site is visible from portions of State 203 west of Highway 395, but the power plant site itself cannot be distinguished from adjacent areas at these distances. Portions of the project site are also open to view from Highway 395 from about 5,000 feet southeast of its junction with State Route 203 to within 1,000 feet of the junction.

The clearest views of the proposed power plant site along Highway 395 are from the northbound travel lanes from about 4,400 feet southeast of its junction with State Route 203 to the junction. A long, low forested ridge to the north of the project site provides a backdrop, as viewed from Highway 395, that serves to minimize the visibility of individual features of the site and of the existing MP I geothermal development northwest of the site.

Highway 395 itself, local roads, the County buildings and impound yard, Mammoth Ski Area, the Mammoth-June Lakes Airport, electric transmission lines, fences, the existing geothermal development, and gas and propane storage tanks -- with their regular outlines, even texture, and colors atypical of the natural environment -- can be seen from the major viewpoint located south of the project site on Highway 395. Mining activities and roads providing access to mining claims and recreational areas also contrast with the generally natural landscape. In the daytime, sunlight reflects from metal and glass surfaces; at night, lights from structures and from cars on Highway 395 can be seen within the generally uninterrupted darkness typical of the natural areas along Highway 395. Night lighting from the existing geothermal plant at Casa Diablo may attract the attention of motorists on Highway 395 and State Route 203.

Major viewpoints in the project vicinity are to the west, away from the proposed project site and toward Mammoth Mountain, the Minarets, San Joaquin Ridge, and Sherwin Bowl.

3.3.6.5 Alternative Power Plant Site

The alternate site is gently sloping wooded area with Jeffrey pine and sagebrush scrub. The site is approximately 0.6 miles north of the proposed site, although the wellfield would be the same as that for the proposed project. Either Substation Road or Antelope Springs Road could be used to provide access to the power plant site, so exposure to viewers is limited. The alternate power plant site is not visible from Highway 395 and is in an area designated for "Partial Retention".

3.3.7 SOCIOECONOMICS

3.3.7.1 General Setting

The population of the Mammoth Lakes region has been steadily increasing over the last two decades. The population grew from 2,213 in 1960 to 4,016 by 1970 and more than doubled to 8,577 by 1980. The rate of growth has slowed significantly in recent years and is estimated to have reached 9,200 by July 1, 1986 (California State Department of Finance, Population Research Unit, 1987). Most of the population of Mono County resides in the recently incorporated Town of Mammoth Lakes, which has a year-round population of approximately 5,000. Peak population on winter weekends reaches 35,000. Employment is concentrated in the government, retail sales and service sectors, with service employment mostly generated by tourism (Hawley, B., 1987). No residents live on or immediately adjacent to the project area.

3.3.7.2 Current Land Use

Current land uses within the vicinity of the proposed project include the following:

- Mammoth Pacific I Geothermal Plant (MP I), immediately adjacent to the site;
- Casa Diablo Substation, operated by Southern California Edison Company, about one-quarter mile northwest of the site;
- Mono County buildings and impoundment yard, one and one-quarter mile east of the site;
- A liquid propane facility, one and one-quarter mile southeast of the site;
- Chance Ranch, a private ranch, approximately one and one-half miles east of the site;
- Sherwin Creek Campground, one and one-half miles southwest of the site;
- Mammoth-June Lakes Airport, three to four miles southeast of the site;
- Forest Service Gravel/Borrow Pits, at the north side of the Airport;
- Sierra Quarry, operated by Honeywell, at the south side of the Airport;
- Hot Creek Hatchery, operated by the Fish and Game, three miles east of the site;
- Old Mammoth School, southwest of the Hot Creek Hatchery;
- Hot Creek Ranch, a private trout fishing resort, four miles east of the site;
- Shady Rest Campground, three miles west of the site;
- 115 kV electric transmission lines;
- Chevron gasoline tank battery about one-quarter mile south of the site; and
- U.S. Highway 395; State Route 203; Hot Springs Road, Antelope Springs Road, Casa Diablo Cut Off Road; an unnamed paved road connecting State Route 203 with Hot Springs Road north of Substation Road; and ten unpaved, unnamed, access roads, all within one-half mile of the project site.

3.3.7.3 Economics

Mono County's economy is primarily based on recreation. Retail revenues are highly seasonal, peaking during the winter skiing season, with a secondary peak during July and August. As illustrated in Table 3-7, sales revenues normally peak in the first and fourth quarters of the year then decrease sharply.

Employment peaks in the first and fourth quarters but has been falling since early 1985 (Table 3-8). Events and activities that negatively affect the skiing season (e.g., late or little snowfall, earthquake activity, or the recent concern over renewed volcanism) dramatically affect the region's economy. The economic and employment imbalance between the inter ski-season and off-season periods is a concern to the community. Summer and spring recreational activities are being promoted to achieve a more balanced tourism industry (Hawley, B., 1987).

The unbalanced nature of the local economy due to its heavy reliance on recreational activities is revealed in the 1983 survey of the Mammoth Lakes labor force summarized in Table 3-9. The survey found no employment in the agricultural, mining, or manufacturing sectors; however, 37% of the labor force was employed in the recreational and service sectors. A large construction sector, 3.5 to four times California's state-wide average, was also present (Earth Metrics, 1984). The operating geothermal plant, MP I, provides sixteen full-time jobs, approximately 0.2% of the local labor force. Eleven of these jobs were filled by residents of Mono County (Asper, W. 1987b).

Fish and Game's Hot Creek Hatchery is important to the economics of the state's trout program. One of only three rainbow trout brood stock hatcheries in California, the Hot Creek Hatchery provides approximately 20 million fish eggs for use in the state's year-round trout program and for use by hatchery systems of several other western states. Hot Creek Hatchery is also responsible for the production and planting of 700,000 catchable trout annually in the Inyo-Mono area and handles the major part of backcountry aerial planting in the northern Sierra Nevada. A unique fall spawning strain of rainbow trout, developed at Hot Creek Hatchery, and the relatively constant temperature of the rearing ponds, provides fish of a plantable size up to six months earlier than typical rainbow trout. This gives California the capability to plant trout all year long. Of the 20 million eggs raised annually at the Hot Creek Hatchery, approximately

40% (eight million) are of the Coleman strain, which can be raised in the winter months (Boone, 1988). Current prices for trout eggs range up to $20 per 1,000 eggs both summer and winter (Neilson, 1988). The value of eggs raised at Hot Creek Hatchery may be as high as $400,000 at current prices.

3.3.7.4 County Fiscal Considerations

Mono County receives revenues from a variety of sources. Total revenues for fiscal year 1985 to 86 were $13,517,524. Approximately 41.6% came from state, federal and other government sources. The remaining 58.4% was from local sources with taxes accounting for 43.2% of total revenues. Charges for county services, licenses and permits accounted for 11%. Income from the use of money and property amounted to about 1.9%. The remaining 2.3% came from miscellaneous sources. The actual dollar amounts of revenues from each of the above sources are summarized in Table 3-10. Geothermal activities accounted for about 6.3% of the revenues. Through possessory interest the county benefits from ad valorem (property) tax revenues paid on the value of geothermal facilities even when the facilities are located on federal land. When the geothermal lease occurs on federal lands, the state receives 50% of the federal lease royalties and rentals and redistributes 20% of the original amount to the county. In addition, geothermal activity at the existing MP I plant supported purchases from local (Mono/Inyo County) merchants totaling $159,000 in 1986 and a direct payroll of $451,173 in 1986 which indirectly increased sales tax revenues (Asper, W., 1987b).

The county expenditures for fiscal year 1985-86 equaled $13,517,824. The largest category of expenditures (30.7%) provided for the general function of the county (i.e., legislative and administrative services, finance services, elections, property management, insurance, and other miscellaneous general services). The next largest categories of expenditures were public protections (22.7%), public ways and facilities (21.1%), and health and sanitation (12.2%). The remainder (13.3%) was spent on public assistance, education and recreation, and reserved for operating contingencies. The dollar amounts for the County of Mono 1985 to 86 budget are presented in Table 3-11. Geothermal lease and royalty revenues from federal lands to the county are channeled into the Geothermal Lease Fund. These monies are used to fund 40% of the County's Energy Management Department and for community improvement purposes largely related to geothermal and recreational facilities. The Fund's balance as of December 31, 1986 was $903,000 (Lyster, D., 1987a).

TABLE 3-7: TAXABLE SALES - MONO COUNTY

Time Period	Sales Revenues
1st Quarter, 1982	$23,133,000
2nd Quarter	16,847,000
3rd Quarter	20,916,000
4th Quarter	22,742,000
1st Quarter, 1983	$24,345,000
2nd Quarter	15,260,000
3rd Quarter	20,891,000
4th Quarter	20,467,000
1st Quarter, 1984	$22,226,000
2nd Quarter	16,709,000
3rd Quarter	22,529,000
4th Quarter	21,642,000
1st Quarter, 1985	$22,487,000
2nd Quarter	17,084,000
3rd Quarter	22,736,000
4th Quarter	21,991,000
1st Quarter, 1986	$28,752,000
2nd Quarter	17,825,000

SOURCE: California State Board of Equalization, Taxable Sales in California, First Quarter 1982-Second Quarter 1986.

3.3.7.5 Community Services

3.3.7.5.1 Schools

The Mammoth School District provides local elementary and secondary education for the area. The former Mammoth Elementary School, condemned due to earthquake damage, is located near the Hot Creek Hatchery, east of Highway 395, and is not currently in service. The new elementary school located adjacent to the Mammoth High School opened in March 1987. However, it is not large enough to handle the current elementary school enrollment and six

TABLE 3-8: EMPLOYMENT IN MONO COUNTY

Time Period	Sales Revenues
1st Quarter, 1983	4,658
2nd Quarter	4,575
3rd Quarter	4,817
4th Quarter	4,808
1st Quarter, 1984	4,708
2nd Quarter	4,512
3rd Quarter	4,558
4th Quarter	4,675
1st Quarter, 1985	5,100
2nd Quarter	4,550
3rd Quarter	4,542
4th Quarter	4,583
1st Quarter, 1986	4,467
2nd Quarter	4,233
3rd Quarter	4,100

SOURCE: California State Employment Development Department, California Labor Market Bulletin, January 1983 to October 1986.

portable classrooms will remain in operation. The district is currently planning to build another wing on the elementary school to relieve the overcrowded conditions. Both elementary and secondary students (as of January 31, 1987) attend classes at Mammoth High School. Many of the classes are conducted in temporary facilities.

The sixteen full-time employees of the MP I geothermal plants have five children attending Mammoth School District and five children attending school in Inyo County (Asper, W., 1987b).

In addition to the problem of overcrowding, the district is also affected by the influx of "transient" students during the winter season. The enrollment level as of January 1987, was

TABLE 3-9: DISTRIBUTION OF MAMMOTH LAKES' LABOR FORCE BY EMPLOYMENT SECTOR 1983 SURVEY

Sector	Percent of All Employees
Agriculture, Forest, Fish	0
Mining, Manufacturing	0
Construction	14
Transportation, Utilities	3
Restaurant, Bar	10
Wholesale, Retail Trade	16
Finance, Insurance, Real Estate	6
Recreation	25
Services	12
Government	6.5
Lodging, Property Management	10
Total Number of Employees	5,559

SOURCE: Earth Metrics, Inc. Mammoth Lake Housing Study Needs, 1984.

TABLE 3-10: GENERAL REVENUES FOR MONO COUNTY

Source	Value
Total Taxes	$5,836,321
Licenses and Permits	146,838
Fines, Forfeitures and Penalties	194,385
Use of Money and Property	252,781
Aid from Other Governmental Agencies	5,625,084
Charges for Current Services	1,343,740
Other Collected Revenues	118,375
Grand Total Revenue	$13,517,524
(Geothermal Revenues)	($793,883)

SOURCE: Mono County Final Budget, 1986 to 1987.

TABLE 3-11: APPROVED EXPENDITURES FOR MONO COUNTY

Category	Amount
General Functions	$4,154,649
Public Protection	3,064,873
Public Ways and Facilities	2,853,109
Health and Sanitation	1,654,854
Public Assistance	823,932
Education and Recreation	296,922
Contingencies	669,185
Grand Total	$13,517,524

SOURCE: Mono County Final Budget, 1986, 1987.

368 elementary students and 293 secondary students. Enrollment drops off just after Easter when the skiing season ends and seasonal employees move their families away. The 1987 faculty consists of fourteen full-time elementary teachers, one part-time elementary teacher, sixteen full-time high school teachers, two part-time high school teachers, and one district teacher. Staffing is not affected by seasonal variation in enrollment (Martin, M., 1987).

3.3.7.5.2 Police

Law enforcement is provided by the Mono County Sheriff's Department headquartered in Bridgeport. There are total of 37 personnel in the department, 24 sworn officers and thirteen public safety officers. The closest officers to the site are four resident deputies located at Crowley Lake providing coverage on an on-call basis. Priority response time to the site is estimated at five to ten minutes (fifteen minutes in the early morning if no one is on duty). Non-priority response is on an "available" basis. The California Highway Patrol has primary responsibility for traffic control and accident investigation for State Route 203 and county roads. The sheriff's department maintains mutual aid agreements with all surrounding law enforcement agencies (i.e., Forest Service, California Highway Patrol, Mammoth Lakes Police,

and Fish and Game). These agencies are called upon only in emergency situations as back-up to the sheriff's department. All arraignments and hearings are held in the Bridgeport courthouse, requiring officers to travel there for testimony and prisoner transfer. No incidents have been reported as of January 26, 1987, at the adjacent MP I geothermal plant (Padilla, T., 1987).

3.3.7.5.3 Medical Facilities

The closest medical facility is the Centinela Mammoth Hospital located in the town of Mammoth Lakes on Sierra Park Road. The Centinela Mammoth Hospital is accredited by the Joint Committee on Hospitals and provides in-patient, out-patient, and 24-hour emergency medical care. The hospital maintains fifteen acute care beds (two in the intensive care unit, thirteen for general services), the structure and equipment for emergency room services, a complete diagnostic materials center, and a local clinic which provides staffing. The staffing level varies with the season, peaking with 75 personnel in the winter and lowering to 50 in the summer. Ten year-round physicians are on the staff. On a year-round basis, the hospital only operates at 30% of capacity. However, the hospital often operates at near-peak capacity during winter weekends. The second and third nearest hospitals are Mono General Hospital in Bridgeport and Northern Inyo Hospital in Bishop. Ambulance service is provided by the Mono County Paramedics for which the Centinela Mammoth Hospital serves as a base station. Additional ambulance service is provided by the centinela Mammoth Hospital, Ground-Aegis Ambulance Service and the Bishop Sierra Ambulance Service, the latter two located in Bishop. Emergency transportation services are provided for by the Care Flight, based at Washoe Medical Center in Reno, Nevada. Burn victims who require treatment beyond local capabilities may be transported to burn centers in Las Vegas, or Sherman Oaks, California (Jacobsen, T., 1987).

3.3.7.5.4 Fire Protection

Local fire protection is provided by the Long Valley Fire Protection District. The district operates three triple-combination pumper engines (two capable of delivering 1,000 gallons per minute and the third capable of 750 gallons per minute) and one automobile out of the Hilton Creek Station located above five miles from the site. Staffing consists of twelve volunteer firefighters and one full-time Chief of Staff. Emergency response time to Casa Diablo, when a crew is available, is estimated at twelve to fifteen minutes. Due to its proximity, the Mammoth

Lakes Fire District, located on State Route 203 near the intersection of Pine Crest, responds to calls in the vicinity. The response time from Mammoth Lakes is approximately seven minutes. The Mammoth Lakes fire station is staffed by a full-time Chief, Assistant Chief and 50 volunteer firefighters. The surrounding Inyo National Forest lands are protected by the Forest Service. Mutual aid agreements are in effect for all surrounding jurisdictions and an automatic aid agreement with the Mammoth Lakes Fire Department. The principal fire concerns in the Casa Diablo area are the use of isobutane at the MP I geothermal plant, the distance from the fire stations, and the limited water supply. In the event of a fire at Casa Diablo, nearby areas of concern are the traffic on adjacent Highway 395; three 10,000-gallon gasoline storage tanks owned by Lloyd Petroleum, located one-quarter mile south of State Route 203 and one-eight mile east of Highway 395; and the 100,000 to 150,000 gallons of propane stored in six tanks owned by Cal-Gas, Petro-Lane, and Turner, located approximately one mile east of the site. Fire safety requirements governing construction are contained in the 1976 and 1982 Uniform Fire Code, with amendments, and special fire protection district provisions (Malby, B., 1987). A fire protection plan for the PLES I Project was prepared by Pacific Energy and approved by the Long Valley Fire Protection District on May 27, 1988 (Lucas, G., 1988).

3.3.7.5.5 Street and Road Maintenance

Street and road maintenance is provided by the county for all non-state and non-federal county roadways. This responsibility includes road repair, maintenance, and snow removal. Snow removal requires up to two-thirds of the total maintenance and improvement budget (WESTEC Services, Inc., 1986). Private roads are maintained by owners.

3.3.7.5.6 Wastewater

The Mono County Water District operates a community sewage system and sewage treatment facility for residents of the Mammoth Lakes and the Lakes Basin areas. The system does not extend to the site area.

3.3.7.5.7 Solid Waste

Mammoth Disposal Service, a private carrier, provides bin service on a contractual basis. The nearest sanitary landfill, a site leased from the Los Angeles Department of Water and Power, is located at Benton Crossing road and is designated Class II, handling normal household refuse and construction debris. The Benton Crossing landfill has a projected lifespan of 25 to 30 years (WESTEC Services, Inc., 1986).

3.3.7.5.8 Utilities

The site is located outside of the water service area of the Town of Mammoth Lakes. A well which supplies non-potable water is located at the adjacent MP I site. The MP I plant receives electricity from the Southern California Edison Company. During 1986, the electrical substation serving the immediate area had a combined designed capacity of approximately 79 megawatts. The site area is currently served by the Continental Telephone Company (Contel) which has general offices and maintenance and switching facilities in Mammoth Lakes (WESTEC Services, Inc., 1986).

3.3.8 HAZARDOUS MATERIALS

Three 10,000-gallon gasoline storage tanks are located approximately one-quarter mile southeast of the project site, and an estimated 100,000 to 150,000 gallons of propane are stored in six tanks located about one mile east of the site (Malby, B., 1987). Both gasoline and propane are considered hazardous because of their characteristic ignitability. Gasoline is also considered hazardous because it is composed of individually toxic chemicals.

The existing Mammoth Pacific I geothermal power plant is located approximately 800 feet west of the proposed PLES I power plant site and stores about 20,000 gallons of isobutane as a working fluid for the binary geothermal heat extraction process. Isobutane is also considered hazardous because of its characteristic ignitability. Physical characteristics of selected hydrocarbon fluids are provided in Table 3-2, Section 3.1.1.2.2. Small volumes of miscellaneous lubricants, paints, and solvents are also stored at the MP I power plant during normal operations.

3.3.9 GEOTHERMAL RESOURCE LEASE

The project area is located entirely on federally administered land within federal geothermal lease CA-11667. The lease was originally issued to Magma Energy, Inc. on March 1, 1982, in what was then known as parcel #12 in the Mono-Long Valley Unit Area. The lease was subsequently acquired by Santa Fe Geothermal, Inc. (SFGI). SFGI became unit operator of the newly designated Long Valley East Unit Area, effective May 10, 1985. Pacific Energy assumed responsibility as agent for exploration activities within the lease from Santa Fe Geothermal on May 8, 1986.

The lease conveys the right to the lessee to explore for geothermal resources within the lease, and the right to develop and use the geothermal resources, if such resources are found to exist; unless, such proposed activity would result in significant, unmitigatable, environmental impacts.

Exploration activities were undertaken by Pacific Energy in 1986 under an approved Plan of Exploration. Those activities confirmed the existence of a commercial geothermal resource within the lease, and Pacific Energy submitted Plans of Operation - Development, Utilization, and Injection to the U.S. BLM for the PLES I Geothermal Development Project, which is the subject of this environmental impact statement.

4.0 ENVIRONMENTAL CONSEQUENCES

Project-specific impacts for all alternatives and cumulative environmental impacts are identified in this section. Measures incorporated in the project to reduce impacts are listed immediately before the mitigation measures and described in each section. The same measures which are included in the project would also be included in the alternatives. Suggested mitigation measures are also provided where appropriate and are numbered sequentially within each major subsection. A qualitative statement and, where information is available, a quantitative statement as to the effectiveness of the suggested mitigation measures and a brief indication of potential environmental impacts are also provided following each suggested mitigation, or group of related mitigations. The anticipated cumulative impacts for each resource are evaluated using a likely scenario for development in the vicinity. The development scenario, which includes a variety of projects in the Mammoth Lakes/Casa Diablo/Hot Creek area, is described in Appendix F.

4.1 PHYSICAL ENVIRONMENT

4.1.1 AIR QUALITY

4.1.1.1 Particulate Emissions

4.1.1.1.1 Proposed Project Impacts

Impact: Particulate emissions, in the form of fugitive dust, would be generated during construction of well sites, the power plant site, and new access roads. Vehicular traffic on unpaved roads would also contribute to fugitive dust emissions. Faster moving vehicles generate more dust than slowly traveling vehicles. The EPA has estimated that about 1.2 tons per acre per month of fugitive dust are generated from construction activities (WESTEC Services, Inc., 1986). About 13 acres of surface would be disturbed by grading and surface disturbance during construction activities, so an estimated 16 tons per month of fugitive dust could be anticipated during the peak construction period. These increases in fugitive dust emissions are expected only to occur near the power plant site during daylight hours when the

nine-month power plant construction period is scheduled. A large fraction of the particulate matter generated by construction activities would settle out of the atmosphere rapidly and would not create a public health problem or affect the air quality of nearby Class I areas.

The proposed project includes the following measures to reduce impacts:

- Soil wetting for dust control would be undertaken as necessary to prevent nuisance violations as defined by the Great Basin Unified Air Pollution Control District. Frequency of wetting would vary dependent upon meteorological conditions, area of disturbed surface, and frequency of traffic across distributed surfaces.
- Unpaved roads would be surfaced with four inches of compacted surface coarse aggregate. Although the paving of all access and surface roads to well sites would further limit fugitive dust emissions from vehicular traffic, it would make reclamation of the site upon abandonment more difficult.
- Disturbed areas would be revegetated, paved, or covered with gravel to limit long-term dust generation.

These dust control measures should reduce particulate emissions to acceptable levels.

Mitigation:

(1) Post and enforce speed limits of 15 mph on unpaved access roads to reduce fugitive dust emissions from vehicular traffic.

Effectiveness/Impact: Vehicles traveling less than 15 mph may reduce fugitive dust emissions slightly. No additional environmental impacts would be associated with this mitigation.

4.1.1.1.2 Alternative Location Impacts

Impact: Particulate emissions would be generated during construction. About 15 acres of surface disturbance would result in an estimated 18 tons per month of fugitive dust during the peak construction period. The timing of the impact would be the same as for the proposed project, as would control measures included in the action.

Mitigation: See mitigation (1) for the proposed project.

4.1.1.1.3 Smaller Power Plant Impacts

Impact: Particulate emissions from about 12 acres of surface disturbance would be an estimated 14 tons per month during the peak construction period. The timing of the impact would be the same as for the proposed project, as would control measures included in the action.

Mitigation: See mitigation (1) for the proposed project.

4.1.1.1.4 No-Action Alternative Impacts

The existing conditions would be unaffected by construction activities.

4.1.1.1.5 Abandonment and Reclamation Impacts

Impact: The power plant operator would be required to plug the wells, remove structures, recontour the ground surface, and revegetate the disturbed areas when the operator determines that field and power plant have reached the end of their commercially useful life. About eight acres would be disturbed in the reclamation process, generating an estimated 10 tons per month of particulate matter. The reclamation process would be accomplished in a much shorter time than the nine-month construction period. See measures included in the proposed project to reduce construction emissions.

Mitigation: No mitigation is recommended.

4.1.1.1.6 Cumulative Impacts

Impact: Intermittent increase in particulate emissions from construction activities would degrade air quality in the Long Valley airshed. A large fraction of the particulate matter generated by construction activities would settle out of the atmosphere rapidly and would not create a public health problem. Smaller particulate matter (PM_{10}) would remain suspended for a longer period of time and may create a health hazard or degrade visibility in nearby areas. If no more than one geothermal project were under construction at one time, the projects would intermittently contribute an estimated 15 to 20 tons per month of fugitive dust during the 36 months of construction. The other construction projects listed in the cumulative scenario,

would disturb approximately 700 acres and would contribute corresponding amounts of dust. The proposed project would contribute less than 2% of the total particulates.

Mitigation:

- Wet soils for dust control on roads and graded areas; surface roads with gravel; and revegetate, pave, or cover disturbed areas to limit long-term dust generation.

Effectiveness/Impact: Particulate emissions would be reduced to acceptable levels.

4.1.1.2 Heavy Equipment Emissions

4.1.1.2.1 Proposed Project Impacts

Impact: Heavy diesel-powered equipment, typically used during construction activities, and diesel-powered drilling equipment would be temporary diesel exhaust emission sources. Estimates of aerial emissions from one piece of heavy equipment operated eight hours a day, five days a week, are provided in Table 4-1. Emissions from diesel-powered heavy equipment would be intermittent and temporary. Great Basin Air Pollution Control District rules would limit NO_x emissions from diesel-powered drilling equipment to less than 250 lb/day per rig.

TABLE 4-1: TYPICAL EMISSIONS FROM A DIESEL-POWERED HEAVY EQUIPMENT ENGINE

Pollutant	Emissions (lbs/week)
CO	16.6
HC	6.3
NO_x	90.8
SO_x	5.7
Particulate	5.6

SOURCE: WESTEC Services, Inc., 1986.

Mitigation: No mitigation is recommended.

4.1.1.2.2 Alternative Location Impacts

Impact: Diesel exhaust emissions would be slightly greater for the alternative location action than for the proposed project because a larger area would be cleared and graded for the power plant and longer pipelines would be required to carry fluid to and from the power plant. The emissions from diesel-powered equipment would be intermittent and temporary.

Mitigation: No mitigation is recommended.

4.1.1.2.3 Smaller Power Plant Impacts

Impact: Diesel exhaust emissions would be slightly less for the smaller power plant alternative than for the proposed project because a smaller area would be graded and cleared for the power plant and fewer wells would be drilled. The emissions would be intermittent and temporary.

Mitigation: No mitigation is recommended.

4.1.1.2.4 No-Action Alternative Impacts

Existing conditions would not be affected.

4.1.1.2.5 Abandonment and Reclamation Impacts

Impact: Diesel equipment would be used in abandonment and reclamation activities, contributing temporary emissions.

Mitigation: No mitigation is recommended.

4.1.1.2.6 Cumulative Impacts

Impact: All construction projects listed in the scenario would require the use of diesel powered heavy equipment. Assuming that heavy equipment usage is proportional to acreage disturbed, the proposed project would account for less than 2% of the total emissions.

Mitigation: No mitigation is recommended.

4.1.1.3 Hydrogen Sulfide Emissions

4.1.1.3.1 Proposed Project Impacts

Impact: Noncondensable gases encountered during drilling operations would be vented to the atmosphere. The noncondensable gases could include hydrogen sulfide (H_2S) a malodorous gas for which a California ambient air quality standard of 0.03 ppm exists, principally to prevent nuisance odors.

There is also an eight-hour permissable exposure limit (PEL) of 10 ppm for H_2S which restricts the concentration of H_2S to which a worker may be exposed during a given work day. There is no federal ambient air standard for H_2S.

During proposed short-term well testing and clean out operations (two to four hours), geothermal fluid would be produced into tanks open to the atmosphere. Noncondensable gases, including H_2S, dissolved within the geothermal fluid would escape as aerial emissions. Mass balance calculations indicate that up to about one kilogram per hour of H_2S would be generated during any given well test or clean out operation (PLES, 1986b). This level of H_2S would be detectable by odor in the immediate vicinity of the well testing or clean out operation but would not be expected to result in concentrations in excess of the H_2S PEL for workers.

The proposed project includes the following measure to reduce impacts:

- A H_2S emergency contingency plan for well drilling and testing operations which includes detection monitoring, training, and emergency response actions for reacting to unsafe concentrations of H_2S (see Appendix A). This measure should protect workers from exposure to unanticipated excess concentrations of H_2S.

Mitigation: No mitigation is recommended.

Impact: A small potential also exists for a rupture in the geothermal production or injection pipelines as a result of a major accident or natural disaster. A worst case estimate of the volume of geothermal fluid which would be spilled before the wells could be shut-in is projected to be the entire production volume of 5,000 gallons per minute for a period of approximately five

minutes. Conservatively assuming that the entire H_2S content of the geothermal fluid would be released to the atmosphere, it is estimated that the H_2S emissions from the incident would total approximately 0.76 kilograms. This rate of emission when averaged over the four production wells, is less than the Great Basin Unified Air Pollution Control District H_2S emission limit of 2.5 kilograms per hour per well.

A well blowout could result in H_2S aerial emissions. Circumstances which could cause a well blowout vary significantly, and the length of time necessary to regain control of a well cannot be easily estimated. During the period of time a well is out of control, a worst-case event assumes the entire content of H_2S entrained in the geothermal fluid would be released to the atmosphere. The maximum credible sustained flow from a well blowout in the area is approximately 685 gallons per minute (Pacific Energy, 1988). This would result in H_2S emissions of approximately 1.2 kilograms per hour, again less than the per well H_2S emission rate allowable under existing Great Basin Unified Air Pollution Control District regulations.

The proposed project includes the following measures to reduce the potential of well blowouts:

- the wells would be cased and cemented from the surface to the production zone; and
- wellhead control would consist of remotely operated, annular blind rams and pipe rams, and manually operated gate valves

Mitigation: No mitigation is recommended.

4.1.1.3.2 Alternative Location Impacts

Impact: Noncondensable gases encountered during drilling operations would be produced at the same rate as for the proposed project but drilling would continue for a longer period since one additional well would likely be drilled.

Mitigation: No mitigation is recommended.

Impact: A rupture in the pipelines carrying geothermal fluid could release the entire production volume of 6,000 gallon per minute for approximately five minutes. Conservatively assuming that the entire H_2S content of the geothermal fluid would be released to the atmosphere, an estimated 0.91 kilograms of H_2S could be released. This is less than the Great Basin Unified Air Pollution District limit of 2.5 kilograms per hour per well.

Mitigation: No mitigation is recommended.

4.1.1.3.3 Smaller Power Plant Impacts

Impact: Noncondensable gases encountered during drilling operations would be produced at the same rate as for the proposed project, but drilling would be carried out over a shorter time period if fewer wells were required.

Mitigation: No mitigation is recommended.

Impact: A rupture in the pipelines which could release the entire production volume of 3,800 gallons per minute for approximately five minutes. If all the H_2S were released to the atmosphere, an estimated 0.58 kilograms would be released. This is less than the Great Basin Unified Air Pollution Control District limit of 2.5 kilograms per hour per well.

Mitigation: No mitigation is recommended.

4.1.1.3.4 No-Action Alternative Impacts

No impacts would occur from the no-action alternative.

4.1.1.3.5 Abandonment and Reclamation Impacts

Impact: Plugging of all wells would eliminate the possibility of H_2S release from the operation. During the process of well abandonment and plugging, there could be short term releases of H_2S from geothermal fluid. BLM requirements for well abandonment would apply.

Mitigation: No mitigation is recommended.

4.1.1.3.6 Cumulative Impacts

Impact: Intermittent H_2S emissions from well drilling, testing, and clean-out operations would cause short-term air quality degradation near Casa Diablo. This would be added to the H_2S emitted from the naturally occurring springs and fumaroles in the vicinity. Assuming that no more than two wells would be drilled or tested at any given time, releases of H_2S would be less than five pounds per hour and would not be significant.

Mitigation:

- No more than two wells shall be tested to the atmosphere at one time, unless it can be demonstrated that the State ambient air quality standard for H_2S will not be exceeded..

Effectiveness/Impact: H_2S emissions would not be significant. No further impacts would be expected from implementation of this measure.

4.1.1.4 Hydrocarbon Emissions

4.1.1.4.1 Proposed Project Impacts

Impact: Fugitive isobutane emissions would occur from miscellaneous leaks in the heat exchanger system. Based on current performance of the existing MP I power plant, fugitive emissions could be expected to amount to less than 250 pounds per day per generating unit, on an annual average basis, as required by Great Basin Unified Air Pollution Control District Permits to Operate.

The proposed project includes the following measures to reduce impacts:

- addition of a gas odorant to each fill of isobutane working fluid to facilitate leak detection;
- routine inventory analysis of isobutane losses;
- periodic leak detection surveys with portable detection equipment;
- repair or replacement of significantly leaking equipment;
- installation of block valves and compressors to evacuate isobutane from the system prior to maintenance operations; and
- use of hydrocarbon leak detection sensors and alarms.

The leak detection program proposed by the project proponent would be expected to assure that fugitive gas emissions would satisfy the Great Basin Air Pollution Control District. Best Available Control Technology would be required by the Great Basin Unified Air Pollution Control District if emissions exceeded the established limits.

Mitigation: No mitigation is recommended.

Impact: A small potential exists for a substantial instantaneous loss of isobutane up to the entire contents of the heat exchanger system, should a catastrophic rupture in the system occur as a result of a major accident or natural disaster. If the entire containment system should empty in this worst-case scenario, up to 20,000 gallons of vaporized isobutane could be lost to the atmosphere. If it were accidentally released during low wind conditions, it would form a visible vapor cloud at ground level. The vapor would irritate the eyes and, if inhaled, could cause dizziness, breathing difficulties, and loss of consciousness. In concentrations from 1.8% to 8.4% with air, the cloud could be ignited. Ground-level isobutane concentrations calculated using a Gaussian "puff" model indicate that immediately downwind of the source, concentrations could be within this concentration range.

The proposed project includes the following measures to reduce impacts of complete or partial loss of isobutane:

- condenser fan drafts would dilute and disperse leaked vapors;
- hydrocarbon sensors and odorant in the isobutane would alert personnel of the event; and
- relief valves and discharge valves would be closed to reduce the quantity of released isobutane.

Strict compliance with applicable building and safety codes and appropriate engineering design and construction would be required by law.

Mitigation: No mitigation is recommended.

4.1.1.4.2 Alternative Location Impacts

Impact: Isobutane emissions and emergency conditions would be the same as for the proposed project. Great Basin Unified Air Pollution Control District permits would limit operating emissions to 250 pounds per day per generating unit. The power plant for each action would have three generating units. The total volume of isobutane in the system would also be the same for both actions. See the discussion in Section 4.1.1.4.1 which describes measures included in the proposed project to reduce impacts.

Mitigation: No mitigation is recommended.

4.1.1.4.3 Smaller Power Plant Impacts

Impact: Potential isobutane emissions would be approximately two-thirds those of the proposed project, because two generating units would be employed instead of three. Great Basin Unified Air Pollution Control District requirements would limit emissions to less than 500 pounds per day. The total volume of isobutane stored on-site also would be less for the smaller power plant than for the proposed plant. See the discussion in Section 4.1.1.4.1 which describes measures included in the proposed project to reduce impacts.

Mitigation: No mitigation is recommended.

4.1.1.4.4 No-Action Alternative Impacts

The only source of isobutane in the project area would be the existing MP I power plant.

4.1.1.4.5 Abandonment and Reclamation Impacts

Isobutane would not be used or stored on the site after abandonment.

4.1.1.4.6 Cumulative Impacts

Impact: The existing MP I power plant and all currently proposed geothermal projects would be binary facilities utilizing a hydrocarbon working fluid to extract heat from the geothermal fluid. Recent fugitive isobutane emissions at MP I have averaged less than 200 pounds per day. Assuming all five geothermal power plants would have similar fugitive emission rates, then approximately 1,400 pounds per day of fugitive hydrocarbon emissions into the Long Valley airshed could result.

The Great Basin Unified Air Pollution Control District recognizes hydrocarbons as precursors to photochemical oxidant air pollutants and has indicated that new binary power plants would be required to obtain Authorities to Construct and Permits to Operate from that agency. Those power plants with hydrocarbon emissions totalling more than 250 lb/day per generating unit would be required to meet New Source Performance Requirements and utilize Best Available Control Technology to minimize hydrocarbon emissions (Hardebeck, E., 1987).

Isobutane is only slightly reactive in atmospheric photochemical reactions; photochemical reactions in the airshed are believed to be limited, not by hydrocarbons, but by relatively low atmospheric concentrations of NO_x in the airshed. It is therefore likely that fugitive hydrocarbon emissions from geothermal development would not significantly increase photochemical oxidant pollution in the air basin.

Estimates based on a simplified model of ground-level concentrations of isobutane from several geothermal power plants indicate that isobutane would not reach dangerous levels from fugitive emissions during normal operations of the five power plants.

Mitigation:

- Adopt hydrocarbon fugitive emission control procedures for all future binary geothermal power plants projects similar to those discussed for the PLES I project (see Section 4.1.1.4.1).

Effectiveness/Impact: The measures would reduce the fugitive hydrocarbon emissions to levels acceptable to the Great Basin Unified Air Pollution Control District. No further impacts of implementation of the measure are anticipated based on current practices.

4.1.2 GEOLOGY, SOILS, AND EROSION

4.1.2.1 Geologic Hazards

4.1.2.1.1 Proposed Project Impacts

Impact: Power plant and wellfield facilities are located in a major active earthquake fault zone and would be subject to severe groundshaking during a major seismic event. All facilities of the proposed project would be designed and constructed in compliance with Uniform Building Code criteria for Seismic Zone No. 4 areas. This measure would be adequate for most seismic events but would not necessarily prevent significant structural damage from a major earthquake centered in the immediate area.

Mitigation: No mitigation is recommended.

Impact: Geothermal water may be near the surface at the proposed power plant site, so that warm artesian water and/or fumaroles could be encountered during grading. This is most likely to occur at the site of the water tank where the deepest cuts would be made during grading. The presence of shallow or surficial warm water or stream would limit the ability to carry out revegetation.

(2) Install piezometers to a depth of 20 feet in order to monitor groundwater levels. Pump groundwater to lower the water table locally if, after construction, it rises to levels sufficiently shallow to damage foundations or otherwise compromise the integrity of the facility.

Effectiveness/Impact: Direct effects of the shallow water or steam on the facility could be mitigated. Disposal of the water could be a problem if it could not be used for irrigation, although injection into the injection reservoir would be an option. The local groundwater table would be lowered which may affect shallow-rooted vegetation. Extensive pumping of groundwater could cause subsidence.

(3) Design foundation and subbase to accommodate shallow groundwater and passively drain the subbase.

Effectiveness/Impact: Direct effects of shallow water would be mitigated. Pumping of shallow groundwater would not be required, minimizing potential impacts to vegetation.

Impact: The project area is located within a volcanically active region. If a major eruption should occur in the region during the life of the project, it could result in a catastrophic spill of geothermal fluids and/or isobutane.

Mitigation: No mitigation is recommended.

Impact: Long-term production of geothermal resources could result in surface subsidence in the area of the production wellfield. A one kilometer long section of the resurgent dome across Casa Diablo subsided at a rate of 15 mm/year near the intersection of Hot Springs Road and Highway 203 in the period between 1986 and 1987 (Savage, 1987). It has not been determined whether this is related to production at MPI or is caused by tectonic activity along nearby normal faults. If it is due to nearby production of geothermal fluids, then the rate of subsidence would likely increase with increased production.

Subsidence can cause structures to sink or tilt and can cause changes in surface drainage. Generally, changes larger than those observed near Casa Diablo would be required to noticeably affect structures or drainage.

The power plant operator is required by the BLM (per GRO Order No. 4 and included in the Plan for Baseline Data Collection) to construct subsidence monuments throughout the project area, to tie them into the established local and regional networks, and to periodically survey the project subsidence network. This activity would detect any significant surface deformation and provide an opportunity to implement mitigation measures in addition to those identified in GRO Order No. 4, if necessary.

Mitigation: No mitigation is recommended.

4.1.2.1.2 Alternative Location Impacts

Impact: Groundshaking impacts would be the same as for the proposed project.

Mitigation: No mitigation is recommended.

Impact: The alternate location action may be located within a fault zone subject to ground rupture or creep, but detailed geotechnical studies have not been done on the alternate power plant site to evaluate seismic hazards.

Mitigation: Perform site-specific studies and relocate those portions of the power plant if necessary if an active fault is found.

Impact: Shallow warm artesian water or fumaroles could be a hazard, but there have been no studies done which suggest this is likely. The presence of relatively tall pine trees on the site suggests that the geothermal water is not shallow enough to inhibit their growth.

Mitigation: If detailed geotechnical work were to indicate shallow warm water or fumaroles were likely, then follow mitigations (4) and (5) for the proposed project.

Impact: Volcanic hazards would be the same as for the proposed project.

Mitigation: No mitigation is recommended.

Impact: Subsidence impacts, if caused by pumping geothermal fluids, would be greater than for the proposed project since approximately 20% more fluid would be produced for the power plant in the alternative location. The same requirements under GRO Order No. 4 would apply to this alternative as to the proposed project.

Mitigation: No mitigation is recommended.

4.1.2.1.3 Smaller Power Plant Impacts

Impact: Groundshaking impacts would be the same as for the proposed project.

Mitigation: No mitigation is recommended.

Impact: Groundrupture and creep impacts would be the same as for the proposed project.

Mitigation: No mitigation is recommended.

Impact: Shallow geothermal fluids may be near the surface at the power plant site. The smaller power plant could be relocated as much as 80 feet and remain within the proposed power plant site. Therefore, the impact could be slightly less for the smaller power plant.

Mitigation: See mitigations (2) and (3) for the proposed project.

Impact: Volcanic hazards would be the same as for the proposed project.

Mitigation: No mitigation is recommended.

Impact: Subsidence impacts, if caused by pumping geothermal fluids, could be less than from the proposed project because less fluid would be pumped for the smaller power plant. The same requirements under GRO Order No. 4 would apply to the smaller project as to the proposed project.

Mitigation: No mitigation is recommended.

4.1.2.1.4 No-Action Alternative Impacts

The present conditions would continue.

4.1.2.1.5 Abandonment and Reclamation Impacts

There would be no facilities to be impacted by geologic hazards.

4.1.2.1.6 Cumulative Impacts

Impacts at Casa Diablo would apply to the one existing and three proposed geothermal projects, and in general, each would be subject to geologic hazards independently of the other projects, except for subsidence.

Impacts: If the recently observed subsidence is indeed caused by production of geothermal fluid either due to collapse of pore space or thermal contraction, then the rate would likely accelerate markedly with the increased production (3,800 gallons per minute increasing to approximately 19,000 gallons per minute). If it is due to tectonic activity alone, then geothermal production would have no impact on subsidence.

Mitigation:

- Recommend that Mono County and the California Division of Oil and Gas adopt the standards contained in GRO No. 4.

4.1.2.2 Soils and Erosion

4.1.2.2.1 Proposed Project Impacts

Impacts: Construction of the power plant, access road, well pads, pipelines and transmission lines would result in soil disturbance. Total site development would result in the temporary disturbance of about 13 acres. After construction, the dirt access roads, cleared areas around wells, and power plant site would constitute about 7.4 acres of unvegetated land which would remain unvegetated for the life of the project.

Disturbance of soil reduces its productivity. In addition, grading or clearing is likely to remove soil from some areas, leaving behind an area difficult to revegetate.

The erosion potential from the proposed surface disturbance will increase if proper precautions are not taken. Receptors for sediment transported from the project include Mammoth Creek and subsequently Hot Creek. Surface water leaving the site flows through the unnamed intermittent creek draining the Casa Diablo area for about 0.6 mile before reaching Mammoth Creek. Under present conditions this provides sufficient time for silt and sand to settle before reaching Mammoth Creek. During intense thunderstorms or when runoff would be extraordinarily high, silt could be carried further and might reach Mammoth Creek, although the capacity of the existing culverts under Route 203 and Hot Springs Road could limit flows and allow some settling to occur.

The proposed project includes the following measures to identify and/or reduce impacts:

- The approved Plan for Baseline Data Collection requires monitoring of the unnamed stream above and below the proposed site to determine effectiveness of erosion control measures.
- Berming well sites during production and injection field drilling and testing activities to contain minor spills on location. Grading sites to direct runoff to sedimentation basins or the mud/reserve pit.
- Diking the power plant site and draining it to a permanent catch basin to collect site runoff. The catch basin would also serve as an emergency containment basin in the event of a significant geothermal fluid spill.
- Constructing all roads to Forest Service standards.
- Following Forest Service "Best Management Practices" for control of erosion based on Forest Service jurisdiction over non-point discharges. This could include using hay bales and filtration fences to remove sediment from runoff before it reaches Mammoth Creek.
- Topsoil from areas which are planned for severe disturbance would be stockpiled for use in revegetation efforts.
- Installing an emergency spill containment system, which is designed to contain any and all discharges from within the project boundaries and which would also be utilized for sediment control during project construction.
- The plant site catchment basin and the emergency spill containment basins would be two separate facilities. The emergency spill containment basins would be of sufficient size to contain approximately forty times the amount of geothermal fluid expected from the maximum credible spill or upset condition.

Mitigation: No mitigation is recommended.

Impact: The spill containment plan (see Appendix A) states that the sluice gates on the spill containment basins would be closed during well drilling and construction activities before the automatic system would be installed. Closure of the sluice gates when the unnamed intermittent stream is flowing could cause an unnecessary accumulation of water.

Mitigation:

(4) Maintain the sluice gates in an open position when the intermittent stream is flowing, except during emergency conditions.

Effectiveness/Impact: The spill containment basins would not accumulate normal stream flow except during emergency conditions. This measure would require manual closure of the valve if the intermittent stream were flowing during construction and a spill occurred large enough to overflow the bermed areas around drill pads and the plant site. This would increase slightly the risk that spilled fluid would reach Mammoth Creek.

4.1.2.2.2 Alternative Location Impacts

Impact: A total of about 15 acres would be disturbed by construction of the power plant at the alternative location. Runoff from the power plant site would travel several hundred yards overland to the unnamed stream and then over a mile to Mammoth Creek. Gulleying could be severe in the highly erodible soil. Without detailed topographic maps of the area it is unclear whether fluids leaving the power plant site would flow north or south of the hill between the site and Highway 395. If the flow were to go north, it could conceivably reach the ephemeral lakes, causing erosion and damaging vegetation en route. Wildlife using the lakes could be impacted.

Mitigation:

- Construct berms so that runoff leaving the site would flow away from the ephemeral lakes.

Effectiveness/Impact: The ephemeral lakes would be protected from additional sedimentation; however, there would be additional soil disturbed and more revegetation and erosion control measures would be required.

Impact: Impacts from closed sluice gates would be the same as for the proposed project.

Mitigation: See mitigation (4) for the proposed project.

4.1.2.2.3 Smaller Power Plant Impacts

Impact: A total of 12 acres would be disturbed. Impacts would be very much like those of the proposed project.

Mitigation: See mitigation (1) for the proposed project.

4.1.2.2.4 No-Action Alternative Impacts

There would be no soil disturbance from the no-action alternative.

4.1.2.2.5 Abandonment and Reclamation Impacts

Impact: About eight acres would be graded and contoured after project abandonment. This area would contribute sediment until the revegetation efforts provided protection.

Mitigation:

- Require erosion control measures to be incorporated in the reclamation plan.

Effectiveness/Impact: Sediment load in Mammoth Creek would be maintained at levels of insignificance. No other environmental impacts would be expected from implementation of this measure.

4.1.2.2.6 Cumulative Impacts

Impact: Each of the proposed development projects (see Appendix F) could contribute to soil erosion during their respective construction phases. About 60 acres would be disturbed by construction of the geothermal projects. Snow Creek, Sherwin Bowl, and Juniper Ridge could involve disturbance of about 400 acres. Doe Ridge may directly impact another 200 acres. These projects would account for about 700 acres of disturbance; PLES I would represent less than 2% of the total.

Mitigation:

- Erosion control measures should be emplaced prior to surface disturbances so that increases in sediment load in the streams are minimized. Revegetation programs should be promptly executed.

Effectiveness/Impact: Careful execution of project-specific mitigation measures during and after construction could be expected to reduce the potential impacts. Revegetation programs would reduce the long-term impact. Emplacement of sediment barriers described in the proposed action prior to surface disturbance would reduce the increment of impact due to PLES I to insignificance.

4.1.3 NOISE

4.1.3.1 Construction Noise

4.1.3.1.1 Proposed Project Impacts

Impacts: Noise from construction-related activities can be divided into noise from heavy machinery used at the site and noise from transporting equipment and workers to and from the site. Construction of the PLES I facility is expected to last nine months. During this period, heavy equipment would generate noise levels similar to those shown in Table 4-2. The peak noise level of 89 dBA, L_{eq}, due to excavation would be attenuated by distance alone to 47 dDA, L_{eq}, at the closest sensitive receptors, the county office buildings, about 1.25 miles to the east. Given existing topography and vegetation, noise from construction activities at the project site would be below ambient levels at the nearest sensitive receptors.

Mitigation: No mitigation is recommended.

Impacts: Pacific Energy anticipates that a maximum of 82 worker would be employed during one month of the construction period. Many of these workers would live in Mammoth Lakes during the construction period and would travel State Route 203 and Hot Springs Road to the project site. This increase in traffic would increase noise levels temporarily when individual vehicles traveled along these roads to about 60 dBA at 10 feet. This would mainly affect cyclists or runners along the State Route 203 and Hot Springs Road in the project area.

TABLE 4-2: TYPICAL CONSTRUCTION NOISE LEVELS AT 50 FEET FROM COMMERCIAL/INDUSTRIAL CONSTRUCTION ACTIVITIES (dBA, L_{eq})/a/

Construction Phase	Average Noise Level (dBA, L_{eq})
Ground Clearing	84
Excavation	89
Foundations	78
Erection	85
Finishing	89

/a/ The L_{eq} is the average noise intensity over the measurement period. Its value tends to be influenced by loud intrusive noises.

SOURCE: Boilt, Beranek, and Newman. 1971. Noise Construction Equipment and Operations, Building Equipment, and Home Appliances. U.S. Environmental Protection Agency.

Mitigation:

(5) Carpooling or busing of workers shall be encouraged.

Impacts: Well drilling noise results from a variety of sources including diesel engines, mud pumps, and electric generators. Drilling equipment would be operated 24 hours per day for twelve to sixteen days at each of eight planned wells. Noise levels from well drilling have been estimated to reach 77 dBA, L_{eq}, at 100 feet (WESTEC Services, Inc., 1986). It is unlikely that more than one well would be drilled at any one time; but, as many as two wells may be drilled simultaneously, and noise levels as high as 80 dBA, L_{eq}, could be produced at 100 feet. This noise level could be annoying to wildlife and people in the vicinity, but would be attenuated by distance to 66 dBA, L_{eq}, at 500 feet and to approximately 44 dBA, L_{eq}, at the county office buildings one and one-quarter miles to the east. Terrain and vegetation would further attenuate these temporary noise levels.

After being drilled, each well would be cleaned out by pumping fluids for two to four hours. Well clean-out would be followed by flow testing for about five days. Noise levels from clean-out and flow testing would probably range from about 75 to 79 dBA, L_{eq} at 100 feet (WESTEC Service, Inc., 1986). Attenuated noise levels would be similar to those described above for well drilling.

Mitigation: No mitigation is recommended.

4.1.3.1.2 Alternative Location Impacts

Impact: Construction noise levels on each site would be the same for the alternate location as for the proposed project; however, the power plant site where most construction activity would take place is located further from the county buildings and Chance Ranch than the proposed power plant site. People using the informal target-shooting area would be affected more by noise from the power plant in the alternate location than at the proposed site. However, since target-shooting itself is a noisy activity, the power plant is unlikely to disturb people using the target shooting area.

Mitigation: No mitigation is recommended.

4.1.3.1.3 Smaller Power Plant Impacts

Noise impacts from construction of the smaller power plant would be the same as those from the proposed project.

4.1.3.1.4 No-Action Alternative Impacts

Noise levels would remain at existing levels.

4.1.3.1.5 Abandonment and Reclamation Impacts

Impact: Heavy equipment used for well plugging, reclamation, and revegetation would generate noise levels comparable to those generated during construction, but for a shorter period.

Mitigation: No mitigation is recommended.

4.1.3.1.6 Cumulative Impacts

Impact: The cumulative projects are far enough apart that, except for MP II & III, none would be audible in the Casa Diablo area. Sherwin Bowl, Snow Creek, and Juniper Ridge projects would be audible in the Town of Mammoth Lakes.

Mitigation: No mitigation is recommended.

4.1.3.2 Operational Noise

4.1.3.2.1 Proposed Project Impacts

Noise levels generated by operation of the power plant would be similar to those generated by the existing MP I facility. Noise levels from the MP I power plant have been measured at 63 to 66 dBA, L_{eq} at 150 feet. Footnote 1, in Section 3.1.3.1, lists examples of typical noise levels for comparison. The PLES I facility would operate 24 hours per day, seven days per week, as does the MP I plant. Addition of a second plant with the capacity to generate noise levels similar to those produced by the MP I plant could result in a combined noise level that would be just noticeably louder than the MP I plant (three decibel increase). Distance, topographic, and vegetative attenuation would reduce noise from these facilities to a level below background levels at all sensitive receptors identified in Chapter 3, Affected Environment. Noise muffling devices are included in the design of the facility.

The project as proposed would comply with applicable federal and state Occupational Safety and Health Administration regulations and Geothermal Resources Operational Order No. 4. Noise levels would not exceed 65 dBA during any geothermal operations at the lease boundary line or 0.8 km (one-half mile) from the source, whichever distance is greater.

Mitigation: No mitigation is recommended.

4.1.3.2.2 Alternative Location Impacts

Impact: The alternate power plant site is located about 0.6 mile from the existing MP I power plant. At that distance, noise from MP I would not be noticeable above background

levels. Therefore, noise generated at the alternative location power plant would function as a separate noise source, rather than blending with the noise from MP I. Like the power plant on the proposed site, the power plant on the alternate site would be required to meet Geothermal Resources Operational Order No. 4.

The noise would affect recreationists and wildlife in the area north and east of the SCE substation where the existing noise levels are low and the proposed project would not be heard.

Mitigation:

- Locate the power plant at the proposed site.

Effectiveness/Impact: Point-sources of noise would be confined to a smaller area and the noise impacts would be reduced.

4.1.3.2.3 Smaller Power Plant Impacts

Noise impacts would be the same as for the proposed project.

4.1.3.2.4 Abandonment and Reclamation Impacts

After abandonment, operational noise would cease.

4.1.3.2.5 No-Action Alternative Impacts

Noise levels would continue at present levels.

4.1.3.2.6 Cumulative Impacts

Impacts: Noise generated by the non-geothermal projects described in Appendix F would be mostly from traffic along Highway 395 and Route 203 leading to Mammoth Lakes. By contrast, geothermal projects' main contributions to noise would be from operation of power plants. The noise would affect people and wildlife near Casa Diablo and in the meadow near the Mammoth / Chance geothermal project. PLES I's contribution to total noise would be localized in effect and small compared to other projects.

Mitigation: Mitigation measures should be determined by responsible agencies on a project-by-project basis.

Effectiveness:

"Discussion of mitigation measures to deal with the cumulative impacts from traffic noise resulting from other proposed projects is best reserved to environmental assessments for those projects which generate substantial traffic and to regional planning documents such as the Noise Element of the Mono County General Plan and the Inyo Forest Management Plan."

Impact: Assuming that each new geothermal power plant would have noise generating and abatement capacities similar to those documented for the existing MP I plant, geothermal-related noise levels would not be audible above background noise at the closest existing sensitive receptors. This analysis is based on (1) a worst-case noise level of 75 dBA, L_{eq}, at 100 feet generated by each power plant unit (noise level without noise muffling devices), and (2) a noise attenuation of three dBA, L_{eq}, at 100 feet generated by each power plant unit (noise level without noise muffling devices). The combined worst-case noise level of the four plants would be 81 dBA, L_{eq}, at 100 feet, which would be attenuated by distance alone to 55 dBA, L_{eq}, at 2,000 feet and to 45 dBA, L_{eq}, at the closest sensitive receptors (Mono County Offices) 1.25 miles to the east. As such, even the combined worst-case noise level, without muffling devices, would not be audible above background noise at the closest sensitive receptors. No noise-sensitive development is currently planned for areas within one-half mile of the project site (Lyster, D., 1987a).

Mitigation: No mitigation is recommended.

4.1.4 WATER QUALITY AND HYDROLOGY

This section is summarized from the separate report on hydrology written by BGI and included as Appendix C.

4.1.4.1 Surface Water Quality

4.1.4.1.1 Proposed Project Impacts

Impact: Spills of geothermal fluid could result from a large pipeline rupture or a well blowout. Temperature effects, though likely to be short-term, would be the most significant impact. The chemical content of the spilled geothermal fluid could cause short-term changes to local creek water chemistry, but would not enter Mammoth Creek due to spill containment structures. The chemical content of the fluid is low in total dissolved solids (TDS) and would not likely have a significant impact for a short-term event. Approximately 760 gpm of fluid from Casa Diablo wells was purposely directed to the creeks for 39 days in 1962 by a former operator. While this caused concern about effects of long-term discharge and potential buildup of trace elements in the potable water supply at Crowley Lake, no catastrophic or lasting effects to the creeks or lake were documented (California Department of Water Resources, 1967 and 1973; Setmire, J.G., 1984).

If a production pipeline carrying the entire plant capacity of geothermal fluid (approximately 5,000 gpm at 335°F) ruptured, a loss of several thousand gallons could result even as various pumps were automatically shut off. This would include spillage from pipes located up-gradient of the broken line which could drain out. If the breakage occurred on the power plant site, the spilled fluid would be contained by a system of dikes and a catchment basin. Outside the plant site, the fluid would flow into the spill containment structure described in Section 2.1.5.1 and Appendix A. Spills from production wells and associated pipelines would drain into the larger basin (design capacity 1,600,000 gallons and maximum capacity 2,180,000 gallons) shown in Figure 2-1. If a production pipeline were to rupture, approximately 15% of the flow would flash to steam as it escaped, while the liquid portion would decrease in temperature to 200°F. The temperature would drop further as the fluid flowed over the ground surface. The larger spill containment basin would be adequate to contain the volume produced by a complete rupture of the largest pipeline flowing for a period of six hours. Well pumping would stop immediately and continuing flow would be reduced to artesian well flow. Artesian wells may continue to flow if automatic valve closures fail, but manual override action would be taken within a probable maximum of one-half hour.

Drainage from three of the four injection well sites (Figure 2-1) would be to the smaller basin (design capacity 92,500 gallons maximum capacity 235,000 gallons). All flow from injection lines would flow onto the ground surface because none of it would flash to steam, but its higher wellhead elevation means that if the pipeline ruptured, the fluid in those parts of the pipeline lower than the break would not drain out, but would remain in the pipeline. Assuming a flow of 5,000 gpm, the smaller basin has adequate capacity to contain the volume of the entire system for about 20 minutes. This would allow ample time for automatic pump shutoff.

Fluid resulting from a well blowout or spill of drilling fluid would also be contained by the basins shown in Figure 2-1. A well blowout could flow unchecked for several days before remedial action (see blowout prevention plan) could be completed. However, the well must first be capable of artesian flow and data thus far indicates a maximum of approximately 700 gpm can be expected. At this rate the larger basin could contain more than 1.5 days flow and the upper basin could contain three hours flow. This estimate is a worst case as it assumes the maximum flow would occur and it does not account for evaporation or percolation losses. The spill containment plans specify that reinjection of the fluid would take place before containment structures are filled. This would allow remedial actions, such as drilling a relief well to be implemented. Any residual fluid or solids remaining on the ground surface would be removed during cleanup operations and should not result in environmental damage.

The proposed project includes the following measures to reduce impacts:

- Follow the Blowout Contingency Plan attached to the Emergency Spill Containment Plan (see Appendix A), including blowout prevention equipment required during drilling (PLES, 1986). During drilling and testing operations store at least 10,000 gallons of cold water on the well site to quench the well should a blowout occur. Another minimum of 220,000 gallons of cold water, stored principally for fire-fighting purposes, should be available during power plant operation.

- Regularly test, maintain and inspect emergency pump shutdown system to ensure proper operation of equipment designed to prevent large spills of geothermal fluid due to pipeline rupture. The testing/maintenance/inspection schedule will be established prior to construction and developed in accordance with GRO Order No. 6.

As a result of these proposed actions, large spills of geothermal fluid within the power plant containment area would be confined to the emergency spill containment basin until it could be reinjected and adverse impacts to Mammoth/Hot Creek would be eliminated.

The spilled fluid would be injected according to the Emergency Spill Containment Plan (see Appendix A). Some percolation of fluid into the local soil would occur; the amount would vary with the season and soil saturation. As long as containment structures were effective, no adverse impacts would occur. Containment structures would not be lined so as to interfere with natural runoff. Should spill containment structures fail, an analysis of the estimated temperature effects for the point at which flow reaches Mammoth Creek is given below.

There is the remote possibility that a catastrophic failure of the road bed of State Route 203 could allow spilled geothermal fluid to leave the larger spill containment basin and flow toward Mammoth Creek before it could cool.

In the worst case, the largest spill would result from a pipeline rupture. Such a spill could last a reasonable maximum of five to ten minutes due to automatic pump shutoff and lack of pumping power. Also, the rupture would have to occur off the plant site since the site itself has sufficient containment capacity behind berms. Off site, a total flowline rupture would allow approximately 4,250 gpm to escape at 200°F. As it traveled toward Mammoth Creek, 0.5 miles distant, significant cooling and percolation would occur which would vary with the time of year. It is difficult to estimate the flowrate and temperature reaching Mammoth Creek, but two limiting impact scenarios are presented:

a) Peak runoff (May-June), high creek flow (82 cfs, 50°F at Mammoth Creek Flume), low percolation (10%), air temperature 65°F (see Appendix C).

Geothermal fluid, 4,250 gpm (9.5 cfs) x 90% = 8.5 cfs

Temperature of spilled geothermal fluid at point of entry to Mammoth Creek - 150°F (estimate)

Temperature of mixed geothermal and stream flow calculation:

Enthalpy of water at 150°F, 12.5 psi = 118 Btu/lb
Enthalpy of water at 50°F, 12.5 psi = 17.5 Btu/lb
(fraction of geothermal fluid x 118 Btu/lbm) + (fraction of creek x 17.5 Btu/lb) = (.104 x 118) + (.896 x 17.5) = 27.9 Btu/lbm

Mixed Temperature = 60°F

This temperature is within the yearly range of Mammoth Creek under normal circumstances.

b) Low runoff (8 cfs, 58°F at MCF), high percolation (30%), air temperature 90°F (see Appendix C)

Geothermal fluid 4,250 gpm (9.5 cfs) x 70% = 6.6 cfs
Temperature at mixing point = 170°F (estimate)
Temperature of mixed water calculation:
Enthalpy of water at 170°F, 12.5 psi = 137.9 Btu/lbm
Enthalpy of water at 58°F, 12.5 psi = 24.9 Btu/lbm
(fraction of geothermal fluid x 137.9) + (fraction of creek x 24.9) = (.543 x 137.9) + (.457 x 24.9) = 86.2 Btu/lbm

Mixed Temperature = 118°F

This temperature effect could last for a maximum of 5 to 10 minutes at the point of entry and be subject to downstream flow and mixing from other tributaries. The contribution from Hot Creek Hatchery (mean flow 17 cfs, 58°F) (Fish and Game, 1988) would allow a reduction to approximately 80°F. No cooling after mixing with Mammoth Creek is assumed. Obviously, some cooling would occur since the air temperature would be 90°F and humidity presumably below 30%.

Mitigation: See mitigation (10) in Aquatic Resources, Section 4.2.3.

Impact: Surface water could be contaminated by runoff from soils previously contaminated by leakage or spills of fuels and other chemical compounds used on the site. The potential for the latter is more likely during well drilling and power plant construction phases due to the presence of machinery, fuels, and chemicals that will be stored and used on site.

The following measures included in the Emergency Spill Containment Plan would minimize the potential for contaminated runoff, from drilling or construction activities, reaching surface waters.

- Immediately remove spilled fluid or contaminated soil for proper disposal.
- Build containment dikes around the spill area of sufficient size to contain the spill until contaminated soils can be removed.
- Begin cleanup immediately.
- Notify appropriate public agencies immediately.

Mitigation: No mitigation is recommended.

4.1.4.1.2 Alternative Location Impact

Impact: Impacts to surface water due to geothermal fluid spills would be greater at the alternative location due to the increased distance the fluid would be piped between the alternative site and the well fields. There may be a potential for contamination of the ephemeral lakes to the west. The proposed containment structures would be in the same location as previously described and a significant amount of cooling and percolation would be likely to occur as the fluid traveled approximately one mile to the basin. Cooling and percolation may reduce temperature and flow to effectively compensate for the additional 1,000 gpm which would be required to run the power plant at the alternate site. All other measures regarding

disposal of the fluid, etc., would be the same as for the proposed project (see Emergency Spill Containment Plan, Appendix A).

The wells would be in the same approximate locations so that spills or blowouts in those areas would have a similar effect as described in Section 4.1.4.1 for the proposed project. See that section for an analysis of effects on Mammoth Creek due to failure of containment structures.

Mitigation: See the mitigation in Soils and Erosion, Alternative Location, Impacts, Section 4.1.2.2.2.

4.1.4.1.3 Smaller Power Plant Impacts

Impact: The only difference between this and the proposed project is the reduced pumping rate (down 24% to 3800 gpm) which allows an additional .5 to .75 hours (for a total of 7 hours) for shut down to be completed before the containment structure is filled to recommended capacity. Impacts due to well blowouts or spills during drilling would be the same as described for the proposed project as would measures to reduce impacts.

Mitigation: No mitigation is recommended.

4.1.4.1.4 No-Action Alternative Impacts

Impact: Even under the no-action alternative, potential impacts to surface water quality exist from spill of geothermal fluid and well blowouts because of existing MPI power plant operation. At present, the potential threat of well blowout, drilling fluid or fuel spills is low or non-existent since no new wells are needed, but it would increase if additional drilling were required to maintain production. Existing berms would contain spills from the current wells and plant site.

In the worst case that these structures failed and the fluid reached Mammoth Creek, such a spill could last a reasonable maximum of five to ten minutes due to automatic pump shutoff and lack of pumping power. Also, the rupture would have to occur off the plant site since the site itself has sufficient containment capacity behind berms. Off site, a total flowline rupture would allow approximately 3,230 gpm to escape at 200°F. As it travels toward Mammoth Creek, 0.5 miles

distant, significant cooling and percolation would occur which would vary with the time of year. It is difficult to estimate the flowrate and temperature reaching Mammoth Creek. Two impact scenarios are presented:

a) Peak runoff (May-June), high creek flow (82 cfs, 50°F at Mammoth Creek Flume), low percolation (10%), air temperature 65°F.

Geothermal fluid, 3,230 gpm (7.2 cfs) x 90% = 6.5 cfs

Temperature of spilled geothermal fluid at point of entry to Mammoth Creek - 150°F (estimate)

Mixed water temperature calculation:

Enthalpy of water at 150°F, 12.5 psi = 118 Btu/lb
Enthalpy of water at 50°F, 12.5 psi = 17.5 Btu/lb
(fraction of geothermal fluid x 118 Btu/lbm) + (fraction of creek x 17.5 Btu/lb) = (0.075 x 118) + (.925 x 17.5) = 24.8 Btu/lbm

Mixed Temperature = 57°F

This temperature is within the yearly range of Mammoth Creek under normal circumstances.

b) Low runoff (8 cfs, 58°F at MCF), high percolation (30%), air temperature 90°F (see Appendix C)

Geothermal fluid, 3,230 gpm (7.2 cfs) x 70% = 5.0 cfs
Temperature at mixing point = 170°F (estimate)
Mixed water temperature calculation:
Enthalpy of water at 170°F, 12.5 psi = 1,137.9 Btu/lbm
Enthalpy of water at 58°F, 12.5 psi = 24.9 Btu/lbm
(fraction of geothermal fluid x 137.9) + (fraction of creek x 24.9) = (.38 x 137.9) + (.62 x 24.9) = 67.8 Btu/lbm

Mixed Temperature = 100°F

This temperature effect could last for a maximum of 5 to 10 minutes at the point of entry and be subject to downstream flow and mixing from other tributaries. The contribution from Hot Creek Hatchery (mean low 17 cfs, 58°F) (Fish and Game, 1988) would allow a reduction to approximately 70°F. No subsurface cooling after mixing with Mammoth Creek is assumed. Obviously, some would occur since the air temperature is 90°F and humidity presumably below 30%.

Mitigation: See mitigation (10), Aquatic Resources, Section 4.2.3.

4.1.4.1.5 Abandonment and Reclamation

Impact: During well plugging operations there is a small chance that geothermal fluid could escape from a well. It would be contained in the spill containment basins.

Mitigation: No mitigation is recommended.

4.1.4.1.6 Cumulative Impacts

Of the existing and proposed projects which could have comparable impacts to the PLES I project, five are considered planned to a point at which impacts may be estimated. These five projects are:

1)	MP I	7 MW	
2)	MP II	10 MW	
3)	MP III	10 MW	
4)	Mammoth Chance I	10 MW	
5)	Sandia/Santa Fe Deep Well	0 MW	(test well only, not a power generation project)

The primary threat to surface freshwater resources from the geothermal projects is from spills of geothermal fluid and petroleum products and other chemicals which may be used on-site during construction, maintenance, or drilling activities. The probability of contamination from spills or natural runoff from contaminated soils is low, but increases with each additional power plant in operation or under construction. However, spill containment features constructed at Casa Diablo for PLES I would also catch spills due to MP I, MP II, and MP III (18,800 gpm total geothermal fluid required) and would be capable of doing so simultaneously with sufficient capacity to allow 1-1/2 hours to complete shutdown. Spill containment features are also planned for the Mammoth/Chance I project.

Assumed ruptured pipelines at four power plants operating at Casa Diablo.

a) Peak runoff (May-June), high creek flow (82 cfs, 50°F at Mammoth Creek Flume), low percolation (10%), air temperature 65°F.

Geothermal Fluid (four power plants) = 15,980 gpm after flash.
Volume after percolation - 14,380 gpm (32 cfs).
Temperature at point of entry to Mammoth Creek - 150°F (estimate).

Calculation:
Mixed Temp (45.7 Btu @ 12.5 psi) = 77.8°F.

b) Low runoff (8 cfs, 58°F at M Creek Flume), high percolation rate 30%, air temperature 90°F.

Geothermal fluid, 11,185 gpm (25 cfs)
Temperature at mixing point = 170°F (estimate)
Calculation:

$$\frac{25 \text{ cfs} \times 137.9 \text{ Btu/lbm} + 3 \text{ cfs} \times 24.9 \text{ Btu/lbm}}{33 \text{ cfs}} = 110.5 \text{ Btu}$$

Mixed Temperature (110.5 Btu, 12.5 psi) = 142.7°F

In both cases, further cooling in Mammoth Creek would occur due to lower air and land surface (creek bed) temperatures and mixing from tributaries downstream.

In the event that spills were to occur at the proposed Sandia/Santa Fe Deep Well site, fluids could travel down Long Canyon and into Mammoth Creek three miles away. Significant cooling and percolation into soils would occur en route so that little or no hot fluid is likely to reach Mammoth Creek. In addition, blowout prevention equipment and drilling practices would be required during drilling. This equipment is estimated to be better than 95% successful in preventing blowouts of geothermal wells (Habel, R., 1988). Further, containment requirements and mitigations would be developed for this deep well, as necessary, through the federal permitting process.

Mitigation: No mitigation is recommended.

4.1.4.2 Shallow Fresh Groundwater

4.1.4.2.1 Proposed Project Impacts

The shallow groundwater at Casa Diablo is associated with shallow alluvial material that appears to thin southeast of Casa Diablo. Based on rock outcrops and drill logs at SF35-32, it is likely that the shallow freshwater resource is discontinuous south of the project area. Chance Ranch, Mammoth/Chance, and Doe Ridge projects are in areas with greater thicknesses of alluvium which are likely to contain larger freshwater aquifers. Shallow cold groundwater would be pumped from the existing well at rates less than 2.5 gpm initially and about 0.1 gpm after landscaping were established. No other users of this resource exist and its contribution to the shallow groundwater resource down gradient is likely to be insignificant based on the relative size of the local resource.

Impact: No impacts are expected.

Mitigation: No mitigation is recommended.

4.1.4.2.2 Alternative Location Impacts

Impacts would be the same as for the proposed project.

4.1.4.2.3 Smaller Power Plant Impacts

Impacts: Slightly less groundwater would be pumped for irrigation because of the slightly decreased area which would be revegetated.

Mitigation: See mitigation (6) for the proposed project.

4.1.4.2.4 No-Action Alternative Impacts

Groundwater use at Casa Diablo would be unaffected.

4.1.4.2.5 Abandonment and Reclamation Impacts

Impact: It is likely that revegetated area would need some irrigation to improve plant survival and growth. Groundwater use would continue until the newly planted vegetation were established. No impacts would be expected.

Mitigation: No mitigation is recommended.

4.1.4.2.6 Cumulative Impacts

Impact: Each power plant at Casa Diablo would need approximately the same quantity of freshwater as MP I, but landscaping requirements would be greater for PLES I, MP II and MP III. Assuming MP III would have irrigation requirements similar to MP II, approximately four times the volume currently produced would be required to support the geothermal projects in the Casa Diablo area during periods of heavy irrigation. The groundwater would be used principally to fill storage tanks for fire-fighting purposes (estimate 96,000 gallons for MP I, 220,000 gallons for PLES I/MP II, and 100,000 for MP III); for sanitation purposes estimated at

an average of less than 0.3 gpm (based on actual use at MP I); and for irrigating landscape and revegetation programs (about 8.0 gpm). After vegetation were established, total use would be less than 0.4 gpm for all four projects. Increased non-potable groundwater production, could lower the freshwater table in the immediate area. No other uses of this groundwater supply are known or anticipated. Shallow-rooted vegetation could be affected if drawdown of the local groundwater should occur from excess pumping at Casa Diablo.

Mitigation: Pumping of groundwater could be limited if vegetation is impacted.

Impact: The other potential and active users of shallow fresh groundwater within the Mammoth Creek Basin include four proposed and one existing geothermal power plant (400 acre-feet/year), the Town of Mammoth Lakes (1900 acre-feet/year), Doe Ridge (642 acre-feet/year), and Sherwin Bowl (471 acre-feet/year) (McAlister, D., 1988). It is estimated that the Town of Mammoth Lakes and the Snow Creek Golf courses would each use about 500 acre-feet/year. These cumulative uses of shallow groundwater would amount to over 4,000 acre-feet/year. The five geothermal projects together would account for less than 10% of the use and PLES I would account for less then 2% and therefore is considered incrementally insignificant.

Mitigation:

- Based on a comprehensive groundwater survey, establish an effective groundwater management policy for the Mammoth Creek Basin. This would need to be a multi-agency and multi-project effort.

4.1.4.3 Hydrothermal Resources

The appeal documentation for the Fish and Game appeal of the BLM approval of PLES I includes a report by a private consultant (Papadopulos Associates, 1988) which attempt to analyze the effects that production will have on the geothermal reservoir. The Papadopulos report concludes by identifying the major issues. These and two other hydrologic issues raised by both the Sierra Club and Fish and Game are also discussed below.

The first issue is that monitoring probably will not provide protection against unexpected adverse impacts of the projects because important adverse impacts cannot be detected until irreversible conditions have been created. This is a unique view and one not shared by scientists and engineers with considerable experience in the Long Valley area including those involved with the Long Valley Hydrologic Advisory Committee. It is universally accepted fact that any changes in pressure and temperature will first occur in the production/injection well bores and diminish rapidly with distance from the wells. There will be nothing "unexpected" regarding pressure and temperature declines in the Casa Diablo area. The Papadopulos analysis itself predicts such effects would occur prior to adverse effects impacting Hot Creek Hatchery or Hot Creek Gorge Springs. Standard reservoir engineering management of geothermal reservoirs worldwide involves continuous or periodic measurement of pressure and temperature within the reservoir. The purpose of standard reservoir monitoring is to detect any changes as early as possible so as to prevent declines from rendering the reservoir useless as a resource. Similar monitoring and management practices have been used for years and are common to related industries such as groundwater production, groundwater pollution abatement, and oil and gas production. There is no evidence to support the contention that declines in reservoir temperature or pressure will be sudden. As with other reservoirs, localized declines can be anticipated, but can be controlled through continued reservoir modeling and production injection management. Any changes that could occur would appear in the immediate area of the production/injection wells and could not appear elsewhere first. Four years of production at the MPI plant has resulted in no declines temperature at the MP I production wells or at thermal discharge areas. These factual data are in contrast to the predictions of the Papadopulos models.

The second issue is related to the first, but is specific to the magnitude of expected temperature declines. The Papadopulos report concludes that, based on 37 MW of power production at Casa Diablo and 10 MW at Mammoth Chance, a temperature decline of 7° to 34°C (13°F to 61°F) at the hatchery and 34° to 68°C (61°F to 122°F) at Casa Diablo can be anticipated after 20 years. This estimate, while based on sound principles, is faulty due to use of an unreasonably low estimate of reservoir size ($3.55 \times 10^9 m^3$) and heat in place (1×10^{17} calories). A more realistic heat in place is considered to be 10×10^{17} calories (Sorey, 1988), which would increase the reservoir volume and reduce the calculated temperature decline in the Fish Hatchery area to less than 4°C after 20 years (see Appendix C). Less conservative estimates of heat in place have ranged from 50×10^{17} calories (USGS, 1980) to 186×10^{17} calories (USGS, 1975). Further, experience with other producing geothermal reservoirs indicates that recharge to the production reservoir is inevitably greater than the combined surface discharge. In fact, in all areas of

geothermal production in the western United States inflow and throughflow of geothermal fluids in the system far exceeds surface discharge. Some commercial geothermal resource areas have no surface discharge.

The idea of significant recharge is shared by those scientists familiar with the Long Valley system, though its path, whether vertical or horizontal, is the subject of some debate. Recharge equal to the current production at Casa Diablo in addition to total surface discharge is not unreasonable to assume. This contention is based on current MPI production, pressure drawdown, and reversals in pre-startup temperature profiles. If this amount were input input to the heat balance calculations it would significantly lower the predicted declines.

In addition, based on water chemistry of Hot Creek Hatchery Springs, two to three percent of the total flow is of thermal origin (Sorey, 1976). Even under very low estimate of 1 $x10^{17}$ calories of stored heat in the hydrothermal system and no recharge, the anticipated change to Hot Creek Hatchery spring temperature is three percent of 7°C (13°F), equal to or 0.2°C (0.36°F). This is well within the natural temperature variation of each spring (see Appendix C).

The third issue is that the hatchery operations would be lost should geothermal production cause a decline in spring temperatures. Spring flows and temperatures fluctuate widely (see Appendix C) according to records kept since 1976. No reasonable scenario suggests that flow will be cut off, but in the worst case, the flowrate and temperature may be reduced two to three percent. Also, the lowest temperature possible could not be less than 11°C (51.8°F), corresponding to the lowest freshwater spring temperature in the source area to the west. This temperature will allow fish hatchery operations to continue, but may reduce productivity.

Fourth, concerns have been raised regarding potential increases in temperature of the hatchery springs. No temperature increases are predicted by any model or calculation as described below: pressure increases in the thermal reservoir beneath the Hatchery area are predicted to equal less than 1.5 feet of water head and cannot be considered likely to increase flow or temperature. Pressure and temperature are related by the laws of thermodynamics. Where pressure increases, which could cause temperature increases, are predicted by the calculations, temperature decreases are predicted by a separate calculation. The exact relationship between temperature and pressure at depth in the thermal reservoir cannot be calculated on the basis of current data.

4.1.4.3.1 Proposed Project Impacts

Potential impacts of geothermal power production on subsurface resources in the Casa Diablo area have been assessed using three independent commonly used techniques. These calculations use conservative values of reservoir parameters in order to obtain predicted reservoir temperature and pressure declines which are larger than are expected. Results approximate a worst-case scenario of reservoir pressure and temperature changes. There is evidence to suggest the assumptions for input data used in these calculations are reasonable, particularly in light of recent drilling and testing since the PLES I EA/EIR. In addition, the power plants are assumed to operate at 100% capacity for the entire 30-year project life. Actually, geothermal power plants operate at 85-95% of capacity. The existing MP I plant has operated at greater than 90% of capacity.

All three methods are employed using the assumptions described in detail in Appendix C. The most important is that a shallow (less than 2000 ft. deep) direct hydrologic communication exists throughout the south Long Valley Caldera. This assumption relates to the Lateral Flow model and provides a worst-case analysis. This model is, as yet, unproven and predicted impacts would be lowered to insignificance if the actual conditions more closely approximate the Upwelling Fracture Flow Model. See Appendix C for details and the rationale for assumptions regarding reservoir parameters used for calculations.

Simulated Reservoir Performance Calculations

The three different methods used to estimate the effects of production and injection were: a) Pressure response modeling, b) Bulk-modeling, and c) Heat (energy) balance analysis.

a) Pressure Response Modeling

This method uses a computer to calculate the reservoir pressure response at a specified location using input data on production and injection well locations and reservoir parameters such as permeability, storage, and fluid viscosity. The program is commercially available and has been used for prediction, test analysis, and management of fractured geothermal reservoirs in the Imperial Valley and the Geysers in California, Steamboat Springs in Nevada, Wairakei in New Zealand and in the Kakkonda, Mistui, and Sugawara fields in Japan. The results in this case

were calculated based on a reservoir with uniform characteristics in all directions, without recharge but with pressure communication between injection and production wells. The calculations, in effect, approximate unlimited lateral communication without the benefit of pressure support through recharge. Power plant start dates of 1985 for MP I and 1990 for PLES I were assumed.

The results are summarized below:

Predicted Pressure Response (psi) in Reservoir

Area	After 10 years	20 years	30 years
Casa Diablo	+2.2	+2.2	+2.2
Hot Creek Hatchery	+0.55	+0.55	+0.55
Hot Creek Gorge	+0.39	+0.39	+0.39

The results show a slight increase in pressure for areas to the east of Casa Diablo. Similar calculations performed for areas to the west show declines on the same order of magnitude (i.e.,< five psi). The calculation chosen for the Casa Diablo area is based on a location southeast of the production area toward the hatchery. The pressure responses to the east are all expected to be positive since all injection would take place on the east side.

Any response, whether positive or negative, less than 10 psi in the producing area of Casa Diablo is not considered significant. For most commercial power plant operations, reservoir pressures may change 10s to 100s of psi over the life of the project. Overall, the results of this calculation (run for 0 to 30 years) are consistent with recent testing and observed pressure response at Casa Diablo. No changes have been detected in the hatchery or Hot Creek Gorge area wells. The pressure response stabilizes after approximately two years of power plant operation due to 100% injection.

This calculation includes MP I startup in 1985 (3,800 gpm) and assumes a 1990 start up for PLES I (5,000 gpm). The pumps are assumed to operate 24 hours a day for 30 years. A lesser impact would result if a realistic plant operation factor (85-95%) were used.

The model results indicate that the 100% injection of fluids on the east side of Casa Diablo prevents pressure in the reservoir from declining at the Hot Creek Hatchery or Hot Creek Gorge areas. The calculation predicts subsurface reservoir pressure changes. The actual effects on

surface features in the worst case would be a linear extrapolation of the reservoir response to the surface. Thus, a 1 psi change in the reservoir would result in approximately 2.5 foot change in the static water level measurement in a geothermal well at the surface. At the hatchery area, about half that pressure change could occur and would not be expected to affect the estimated 97% fresh water component of the springs.

(b) Bulk-Model Calculation

A second calculation was performed in an attempt to estimate the distance that the cooler injected fluid would move from Casa Diablo and therefore, predict the potential for interference of cooler injected fluid with hot regions beneath springs. This calculation is based on assumptions of thermal properties and porosity of the rock and reservoir fluid and that the displacement of fluid would be outward in an approximately uniform cylindrical front. An injection fluid temperature of 175°F into a 300°F zone and a reservoir thickness of 500 feet were also assumed for this calculation. Continuous injection of 3,800 gpm for MP I and 5,000 gpm for PLES I were assumed with startup dates of 1985 and 1990, respectively. Appendix C gives a full description of methods and assumptions used for this calculation. The differences between the input data required for this calculation and the other two calculation methods are also given in Appendix C.

Results of the Bulk Model calculations are:

Distance of Thermal Front from Project Area		
After 10 years	After 20 years	After 30 years
730 feet	1030 feet	1260 feet

The hydrodynamic front would expand outward at a faster rate than the thermal front. The calculated position of the thermal front indicates that the distance cooled fluid moves away from the injection wells is approximately 1,260 feet in 30 years.

This calculation is simplistic, but useful for comparison with other models. In reality, fractured rock could allow preferred flow paths to carry injected fluid far beyond the calculated fronts. However, experience in fluid injection indicates distortion of the fronts is limited in pervasively

fractured geothermal reservoirs. An extremely abnormal flow pattern would be required for the lower temperature fluid to travel as far as Hot Creek Hatchery (approximately three miles distant) or Hot Creek Gorge (about five miles distant). It is also significant that gravity segregation has not been accounted for in this calculation. This effect allows colder fluid to sink deeper into the reservoir, decreasing the probability of near surface consequences.

A porosity of 5% was used for these calculations. Estimates of porosity at Casa Diablo are currently twice that amount but the above approximates a worst-case scenario. A high porosity, such as the 15% used in the heat balance calculation below, would reduce significantly the distance the front would travel. A low porosity value gives worst-case results for the bulk model but the opposite is true for the heat balance method (see below and Appendix C). It is also possible that the effective injection zone thickness is greater than the 500 feet assumed for this calculation. A greater thickness would cause a decrease in the radial extent of the hydrodynamic and thermal fronts, hence the lower value of 500 feet is also a worst-case assumption.

A separate calculation related to distortion of the bulk-model thermal front was performed. It is based on the subsurface hydraulic gradient which may induce lateral west-to-east flow. The effect of this gradient would be to cause greater movement of the injected fluid down-gradient to the east and this is not accounted for in the bulk-model. A rough estimate of its possible effect can be calculated from the regional geothermal/groundwater gradient. A fluid velocity of 0.06 feet per day was calculated based on the same horizontal permeability value used in the computer model and a value for the local geothermal/groundwater gradient map of 0.0135 feet/foot, estimated from the water (including geothermal water) level contour map of Farrar, C.D., et al. (1985).

The results indicate that fluid moving from Casa Diablo would take about 100 years to reach Hot Creek Hatchery and 150 years to reach Hot Creek Gorge. These results are based on the assumption that lateral west-to-east subsurface flow occurs in the region, with no provision made for the effect of preferred flow paths, features often associated with fractured reservoirs. However, calculation of the movement of fluid in the subsurface induced by the local groundwater gradient did not take into account reheating of injected fluid through contact

with hot reservoir rock and this effect would cause the fluid moving through the rocks to warm by conduction as it moved from west to east. In addition, fluid in preferred flow paths represents a relatively small volume of fluid with a large surface area which allows rapid reheating to occur thus reducing the likelihood of temperature changes in spring flow by this mechanism.

Even if injected fluid reaches the subsurface zones below the surface springs, it would not necessarily result in cooling of springs or decreasing flow rates. The estimated position of the thermal front, including some distortion by lateral flow, indicates breakthrough of cool injection fluid is not likely to be a potential threat to existing springs.

c) Heat (Energy) Balance

A third method was used to calculate the potential for temperature impacts on the reservoir in the area of concern, particularly the hatchery and Hot Creek Gorge areas. This approach is used in the Mammoth/Chance EIR (WESTEC, 1987) and in a report by S.S. Papadopulos and Associates in an attempt to evaluate the impacts of geothermal development (Papadopulos, 1988). The analysis here, taken from Appendix C, instead of the low value of heat in place of 1×10^{17} calories and high porosity of 35% that the Papadopulos report uses, values of 10×10^{17} calories and 15% porosity were used for this analysis. This analysis can be considered a worst-case scenario when combined with assumptions of 100% plant operation and no recharge to the system except that equal to measurable surface discharge. The equations, assumptions, and volumes considered are given in detail Appendix C.

The results of this analysis which includes existing MP I and proposed PLES I are summarized below:

	Predicted Temperature Change in Reservoir		
Area	After 10 years	20 years	30 years
Casa Diablo	-5.6°C (-10.1°F)	-10.7°C (-19.3°F)	-15.4°C (-27.7°F)
Hot Creek Hatchery	-0.5°C (-0.9°F)	-1.9°C (-3.4°F)	-2.6°C (-4.7°F)
Hot Creek Gorge	-0.0°C (0.0°F)	-1.0°C (-1.8°F)	-2.0°C (-3.6°F)

Most producing geothermal reservoirs, like those listed below, show little surface discharge in relation to their reservoir heat capacity and geothermal power potential. Therefore, the heat balance approach does not provide an accurate indication of subsurface conditions.

Geysers, California	1800 MW
Imperial Valley, California	100 MW
Steamboat Springs, Nevada	10 MW
Wairakei, New Zealand	150 MW
Larderello, Italy	365 MW
Cerro Prieto, Mexico	200 MW

Impact: It is difficult to predict the effects on surface thermal features resulting from production/injection operations at the proposed PLES I Project and the existing MP I power plant. The model calculations described here indicate that the potential for measurable subsurface impacts to extend three to five miles to Hot Creek Hatchery and Hot Creek Gorge is very low. Special circumstances exist at each area, such as those at the hatchery springs, where it is estimated that approximately 2% to 3% of the flow is thermal water. The temperature of the thermal fluid component of these springs is unknown; but it is estimated that a loss of the entire thermal component could result in a lowering of average spring temperature of 2° to 3°C (Sorey, M.L., 1976). No effects have been measured at Hot Creek Gorge or hatchery springs to date and none would be anticipated on the basis of the reservoir measurements at Casa Diablo.

The project includes the following measures, also listed in Section 2.1.1, item 23, to identify and reduce potential impacts:

> The following mitigation process will be used to mitigate potential hydrothermal impacts on the Owens tui chub and may be modified as appropriate to mitigate impacts to Hot Creek Hatchery and Hot Creek Gorge springs:
>
> a) The operator shall be responsible for reporting to the authorized officer the monitoring measurements required to be collected by the Plan for Baseline Data Collection (PBDC) approved for the project, or any other monitoring data which may be required by the authorized officer. The approved PBDC will incorporate the monitoring program recommended for the project by the Long Valley Hydrologic Advisory Committee (LVHAC) dated October 1987, as corrected, and shall require monitoring information be collected and reported for the C-D Hot Creek headsprings comparable to that recommended by the LVHAC for the A-B Hot Creek headsprings which is Critical Habitat for the endangered Owens tui chub.

b) The authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub, will evaluate the monitoring data and consult with the U.S. Geological Survey, the California Division of Oil and Gas, the County of Mono, and the U.S. Fish and Wildlife Service, if appropriate (the "consulting agencies"), regarding the analysis of the data and the development of mitigating measures as indicated appropriate by the conclusions of the analysis of the data.

c) If the authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub, determines a need to supplement monitoring information developed from existing Monitoring Well 65-32, a second monitoring well may be required to be drilled, maintained, and monitored in conformance with the requirements of Stipulation 23(a) (above). The well shall generally be located in the area of Colton Springs, with the specific location to be determined by the authorized officer and the appropriate governmental agencies with land use jurisdiction. The authorized officer may also require mitigation actions in addition to the second monitoring well including, but not limited to, one or more of the following actions:

(1) Temporarily modify the production or injection of geothermal fluids within the field and monitor the reservoir response. Modification could include one or more of the following:

(i) Change fluid volumes or pressures in one (1) or more wells;

(ii) Discontinue use of one (1) or more production or injection wells; or

(iii) Relocate one (1) or more production or injection wells.

d) If the authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub, determines that monitoring information from the second monitoring well (located near Colton Springs) and all other monitoring information indicate a need for further information with respect to a threat posed by plant operations to beneficial uses of thermal water, or to the continued existence of the Owens tui chub, the authorized officer may require that a third monitoring well be drilled, maintained, and monitored in conformance with the requirements of Stipulation (a) (above). The well shall generally be located in the area between Colton Springs and the Hot Creek headsprings, with the specific location to be determined by the authorized officer and the appropriate governmental agencies with land use jurisdiction.

e) If the authorized officer, in cooperation with the U.S. Fish and Wildlife service regarding the Owens tui chub, determines that monitoring information from the second monitoring well (located near Colton Springs) and all other monitoring information indicate that plant operations may threaten an unacceptable impact to other current beneficial uses of thermal water, or threaten a reduction in the temperature of the A-B or C-D Hot Creek headsprings, one or more mitigation actions, including but not limited to, those listed in paragraphs c(1) and c(2) above, shall be required. In reaching a decision, the authorized officer shall consider, among other factors, the recommendations of the consulting agencies.

f) After monitoring the third monitoring well, (located in the area between Colton Springs and the Hot Creek headsprings), should the authorized officer determine that plant operations threaten an unacceptable impact or are resulting in an unacceptable impact to beneficial uses of thermal water, or threaten a reduction or are resulting in a reduction in the temperature of the A-B or C-D Hot Creek headsprings, one or more mitigation actions, including, but not limited to, those listed in subparagraphs (a) through (d) below shall be required. In reaching a decision, the authorized officer shall consider, among other factors, the recommendations of the consulting agencies.

(1) Temporarily modify the production or injection of geothermal fluids within the field and monitor the reservoir response. Modification could include one or more of the following:

(i) Change fluid volumes or pressures in one (1) or more wells;

(ii) Discontinue use of one (1) or more production or injection wells; or

(iii) Relocate one (1) or more production or injection wells.

(2) Permanently modify the production/injection program.

(3) Provide an alternate source of thermal water to the affected Hot Creek headspring(s). Such thermal water shall be conveyed to the Hot Creek headspring(s) in a manner that does not facilitate the introduction of other fishes into the headsprings.

(4) Reduce or discontinue power production.

g) If monitoring activities of the three monitoring wells described above indicate a progressive temperature decline is occurring that threatens a change of temperature at the Hot Creek headsprings, A-B or C-D, or threatens the continued existence of the Owens tui chub, the operator shall, at a minimum, implement the mitigation action described in Stipulation f(3) above.

h) The Operator shall be responsible for maintaining the thermal water conveyance facilities described in Stipulation f(3) above for as long as an alternate source of thermal water is needed to maintain water temperatures in the affected Hot Creek headsprings at levels existing prior to the onset of impacts from plant operations.

i) The Operator shall establish a funding mechanism to ensure that the mitigation actions described in Stipulations (a) through (h), above, will be implemented in a timely manner. Such funding mechanism shall be provided either directly through the provision of materials and services needed to satisfy the monitoring and alternate thermal water supply requirements described above, or indirectly, through insurance, performance bond, dedicating project revenues to a special escrow account or other mechanism acceptable to the authorized officer. The funding mechanism shall be developed by the Operator in consultation with the authorized officer and the U.S. Fish and Wildlife Service, and agreed to by the authorized officer in cooperation with the U.S. Fish and Wildlife Service, prior to the commencement of geothermal production by the Operator.

This mitigation process was designed to reduce to insignificance the possibility of impacts to any of the sensitive hydrothermal features by implementing a program of monitoring the hydrothermal system at numerous points to detect any potentially adverse changes so that mitigation measures could be implemented before those changes reach the sensitive hydrothermal features. This hydrothermal system monitoring program would establish additional baseline data, detect changes caused by project operations before they could affect hydrothermal features of concern, provide information to select and implement appropriate mitigations to prevent hydrothermal changes from migrating away from the production field toward the sensitive hydrothermal features, and monitor the effectiveness of the implemented mitigation. The data to be collected by the operator are listed in the Plan for Baseline Data Collection discussed in Chapter 2.

The proposed monitoring program is progressive; that is, the results of initial monitoring may result in the establishment of additional monitoring, and possibly the drilling of additional monitoring wells. It was designed to provide documentation of any progressive movement of hydrothermal system changes away from the Casa Diablo project area toward the Hot Creek Hatchery and other areas of concern. Finally, it was intended to provide the information necessary to select, implement, and monitor those mitigation measures appropriate to prevent any detected adverse hydrothermal system changes from reaching the thermal features of concern.

The proposed hydrothermal mitigation program consists of several techniques which are commonly used in geothermal and oil and gas wellfield operations to manage pressure changes within the reservoir. Geothermal wellfield operations basically consist of the production and injection of large quantities of water so that the heat in the reservoir can be extracted. To produce water from a geothermal well, the pressure in the well is reduced so that water flows from the geothermal reservoir into the wells, and then to the surface. Injection wells reverse this process; increasing the pressure in the injection well forces the water into the injection reservoir, slightly increasing the reservoir pressure in the injection zone.

Impact: Without a mechanism for establishing trigger points, implementation of mitigations may be delayed or prematurely implemented thereby reducing the mitigations effectiveness.

Mitigation:

(6) Replace item 23 in Section 2.1.1 with the following:

The following monitoring and remedial action program is designed to prevent, or mitigate, potential hydrothermal impacts to the Owens tui chub critical habitat, Hot Creek Hatchery, and Hot Creek Gorge springs:

a) The operator shall be responsible for reporting to the authorized officer the monitoring measurements required to be collected by the Plan for Baseline Data Collection ("PBDC") approved for the project, or any other monitoring data which may be required by the authorized officer. The approved PBDC will incorporate the monitoring program recommended for the project by the Long Valley Hydrologic Advisory Committee ("LVHAC") dated October 1987, as corrected, and shall require monitoring information be collected and reported for the C-D Hot Creek headsprings comparable to that recommended by the LVHAC for the A-B Hot Creek headsprings which is critical habitat for the endangered Owens tui chub.

b) The operator will fund an independent expert, acceptable to the authorized officer, to conduct annual technical analyses and evaluations of hydrological monitoring data and will provide all results of these analyses and evaluations to the authorized officer in a timely manner.

c) If the authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub, and in cooperation with the California Department of Fish and Game regarding the Hot Creek Hatchery and Mammoth Creek/Hot Creek, determines a need to supplement monitoring information developed from existing monitoring well SF 65-32, the operator shall drill a second monitoring well to be maintained and monitored in conformance with the requirements of Stipulation (a) above. The well shall be sited at a location to be determined by the authorized officer and the appropriate governmental agencies with land use jurisdiction, in consultation with U.S. Geological Survey.

d) The authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub and in cooperation with the California Department of Fish and Game regarding the State Fish Hatchery and Mammoth Creek/Hot Creek, will at a minimum, annually evaluate the monitoring data and consult with the U.S. Geological Survey, the California Division of Oil and Gas, the County of Mono, the U.S. Fish and Wildlife Service, and California Department of Fish and Game (the "consulting agencies"), if appropriate, regarding the analysis of the data and the implementation of mitigating measures as indicated appropriate by the conclusions of the analysis of the data.

e) If the authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub and in cooperation with the California Department of Fish and Game regarding the Hot Creek Hatchery and Mammoth Creek/Hot Creek, determines that monitoring information from the existing monitoring well SF 65-32 and all other monitoring information indicate that:

(1) Pressure, temperature, and/or chemical/changes or trends are occurring within the production or injection fields in excess of the anticipated variations, based on production experience;

(2) Pressure, temperature, and/or chemical changes or trends are occurring within the monitoring well(s) in excess of the anticipated range of variation; or

(3) Plant operations may threaten an unacceptable impact to other current beneficial uses of thermal water, or threaten a change in the temperature of the A-B or C-D Hot Creek headsprings, then the operator shall, as required by the authorized officer, immediately implement one or more of the following mitigation actions:

(i) Temporarily modify the production and/or injection of geothermal fluids within the field and monitor the reservoir response. Modification could include one or more of the following:

- change fluid volumes or pressures in one (1) or more production or injection well(s);
- discontinue use of one (1) or more production or injection well(s);
- change the depth of injection;
- relocate one (1) or more production or injection well(s); or
- any other measures as directed by the authorized officer, or

(ii) Permanently modify the production and/or injection program.

In reaching a decision regarding the implementation of mitigation measures, the authorized officer shall consider, among other factors, the recommendations of the consulting agencies.

f) If the authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub and in cooperation with the California Department of Fish and Game regarding the State Fish Hatchery and Mammoth/Hot Creek, determines the monitoring information from the second monitoring well and all other monitoring information indicate a need for further information with respect to a threat posed by plant operations to beneficial uses of thermal water, or to the continued existence of the Owens tui chub, the operator shall drill a third monitoring well to be maintained, and monitored in conformance with the requirements of this stipulation. The well shall generally be located in the area between Colton Springs and the Hot Creek headsprings, with the specific location to be determined by the authorized officer and the appropriate governmental agencies with land use jurisdiction, in consultation with the U.S. Geologic Survey.

g) If the authorized officer, in cooperation with the U.S. Fish and Wildlife Service regarding the Owens tui chub and in cooperation with the California Department of Fish and Game regarding the Hot Creek Hatchery and Mammoth Creek/Hot Creek, determines that monitoring information from the second monitoring well and all other monitoring information indicate that plant operations may threaten an unacceptable impact to other current beneficial uses of thermal water, or threaten a change in the temperature of the A-B or C-D Hot Creek headsprings, one or more mitigation actions, including but not limited to, those listed in paragraph e) above, shall be required. In reaching a decision, the authorized officer shall consider, among other factors, the recommendations of the consulting agencies.

h) After monitoring the third monitoring well (located in the area between Colton Springs and the Hot Creek headsprings), should the authorized officer determine that plant operations threaten an unacceptable impact or are resulting in an unacceptable impact to beneficial uses of thermal water, or threaten a change or are resulting in a change in the temperature of the A-B or C-D Hot Creek headsprings, one or more mitigation actions, including, but not limited to, those listed in subparagraphs (1) through (4) below shall be required. In reaching a decision, the authorized officer shall consider, among other factors, the recommendations of the consulting agencies.

(1) Temporarily modify the production or injection of geothermal fluids within the field and monitor the reservoir response. Modification could include one or more of the following:

(i) Change fluid volumes or pressures in one (1) or more injection or production well(s);

(ii) Discontinue use of one (1) or more production or injection well(s);

(iii) Change the depth of injection; or

(iv) Relocate one (1) or more production or injection well(s).

(2) Permanently modify the production and/or injection program.

(3) Provide an alternate source of thermal energy or water to the affected Hot Creek headspring(s). Such thermal energy or water shall be conveyed to the Hot Creek headspring(s) in a manner that does not facilitate the introduction of other fishes into the headsprings.

(4) Reduce or discontinue power production.

i) If monitoring activities of the three monitoring wells described above indicate a progressive temperature or pressure change is occurring that threatens a change of temperature at the A-B or C-D Hot Creek headsprings, or threatens the continued existence of the Owens tui chub, the operator shall, at a minimum, implement the mitigation action described in Stipulation h (3) above.

j) The operator shall be responsible for maintaining the thermal energy or water conveyance facilities described in Stipulation h (3) above for as long as an alternate

source of thermal energy or water is needed to maintain water temperatures in the affected Hot Creek headsprings at levels existing prior to the onset of impacts from plant operations.

k) The operator shall establish a funding mechanism to ensure that the mitigation actions described in this stipulation will be implemented in a timely manner. Such funding shall be provided either directly through the provision of materials and services needed to satisfy the monitoring and remedial action requirements described in this stipulation, or indirectly, through insurance, performance bond, dedication of project revenues to a special escrow account or other mechanism acceptable to the authorized officer. The funding mechanism shall be developed by the operator in consultation with the authorized officer in cooperation with the U.S. Fish and Wildlife Service and the California Department of Fish and Game, prior to the commencement of geothermal production by the operator.

Effectiveness: The sequence of actions defined by the revised stipulation listed above will ensure the beneficial uses of the geothermal resource by its flexibility and responsiveness. The following steps, carried out the BLM in cooperation with the consulting agencies listed in the stipulation, either have been taken already or would be taken as necessary.

STEP 1: The first monitoring well (65-32, see Figure 2-1) has already been drilled by Pacific Energy east of the proposed PLES I well fields. This well, on the basis of pressure responses to changes in pumping at the MP I production wells, is clearly monitoring conditions in the production reservoir and indicating the extent to which reservoir changes may propogate in a direction toward Hot Creek. Data on pressure and temperature in production and injection reservoirs are being collected from the newly instrumented and continuously monitored wells at MP I. Water from the production wells is sampled and analyzed periodically. The same kind of information would be collected in the wells at PLES I wells.

Other baseline data are being collected at AB and CD springs at the hatchery and at other locations (see the Hydrologic Monitoring Plan Section 2.1.7). On the basis of these data, the BLM and consulting agencies will evaluate normal variability in the observed features (see Section 4.1.4.3.1). These normal variation levels become the "trigger points" which will be used to trigger the implementation of the described wellfield mitigation measures.

STEP 2: A second monitoring well may be drilled between well 65-32 and Colton Springs if the authorized officer determines, based upon review of any new monitoring or wellfield operation data collected and after discussion with the consulting agencies, that additional

monitoring data is necessary or advisable. At present, none of the monitoring or wellfield operation data indicate the need to drill and monitor such a well. Its location would be determined by the BLM and those governmental agencies with land use jurisdiction. It would be monitored in the same way 65-32 is being monitored. There are no surface manifestations of the geothermal resource between Casa Diablo and Colton Spring, so a guarantee of hydrologic communication with the production reservoir may be more difficult to provide the further the well is from Colton Spring.

At this point, it is worth reviewing the two conceptual models of the production reservoir, which were discussed in Chapter 3, Section 3.1.4. For purposes of considering a worst-case situation, this analysis has assumed the Lateral Flow model which calls for fluid to originate on the west side of Long Valley Caldera and flow through the reservoir rocks toward the east/southeast while cooling. In this model, fluid moves vertically along faults to stay within the permeable reservoir rocks. The reservoir, although offset along faults, is considered widespread and continuous in the southwestern part of the caldera. Colton Spring's thermal component would come from the same reservoir as the springs, fumaroles, and wells at Casa Diablo. If the second observation well penetrated a reservoir of the proper temperature and depth, it would almost certainly be in hydrologic communication with the production reservoir if the Lateral Flow model is generally correct. If the Upwelling/Fracture Flow model more accurately reflects existing conditions, then there is no risk that the effects of production or injection at Casa Diablo would propagate toward the resources underlying the hatchery or Hot Creek Gorge because each area would be fed by a separate reservoir. This is not the assumption which has been made for this analysis, since such an assumption would render the phased monitoring program and associated mitigation measures unnecessary.

STEP 3: Monitoring results from MP I and PLES I production, injection and monitoring wells would be analyzed to detect changes or trends in pressure, temperature, and/or chemistry outside of the established "trigger points," the range of anticipated variations based on previous operational experience. This would provide the most immediately available data on impacts to the geothermal reservoir. As discussed in Section 4.1.4.3, geothermal reservoir changes would originate in the geothermal reservoir at Casa Diablo before moving toward the hatchery. It would also be in the self-interest of Mammoth Pacific and Pacific Energy to manage the reservoir to maintain its viability for power generation.

The resource at Casa Diablo is at a relatively low temperature for efficient power generation, especially using air-cooled condensers. If production or generation operations at MP I and PLES I caused changes in the reservoir which threatened their operation, reservoir management techniques would be used to reduce or reverse those changes.

The selection of the proper reservoir management technique or techniques to implement (from those listed, or others, as appropriate) would depend upon the change in the geothermal reservoir detected by the monitoring program, and the other information provided by the entire hydrologic monitoring program. These reservoir management techniques have been proven effective in other geothermal, oil and gas, and groundwater fields, and there is every reason to believe that they will be effective in these situations. The authorized officer has the authority to require the lessee to implement any necessary wellfield operation changes as mitigation measures under the Geothermal Steam Act of 1970, the Act's implementing regulations, and the geothermal lease. To date, reservoir parameter changes have not required the use of any reservoir management technique at MP I.

STEP 4: If information from the monitoring wells or any other phases of the monitoring program indicated the need for further information, another monitoring well would be drilled. It would be located between Colton Spring and the Hot Creek headsprings at the hatchery. The same arguments about its hydrologic communication with the geothermal reservoir as were given for the second monitoring well would apply: that is, the well is likely to be in hydrologic communication with the geothermal reservoir if it encounters a reservoir of the appropriate depth and temperature under the assumptions of the Lateral Flow Model.

STEP 5: If the authorized officer determines, based upon the available monitoring and any other information, that operations may threaten an unacceptable impact to other current beneficial uses of thermal water, or threaten a reduction in the temperature of the A-B or C-D Hot Creek headsprings, the authorized officer will require that one or more of the wellfield mitigation measures identified in the stipulation above be implemented. As stated above, the selection of proper reservoir management technique or techniques to implement (from those listed, or others, as appropriate) would again depend upon the change in the geothermal reservoir detected by the monitoring program, and the other information provided by the entire hydrologic monitoring program.

STEP 6: A significant impact to the geothermal reservoir is not predicted by the various models and is considered highly unlikely. Nevertheless, the progressive monitoring/mitigation program provides the specific means by which any changes, large or small, in the geothermal reservoir can be detected and then, as necessary, mitigated so that the water temperature is maintained at Hot Creek headsprings, which ensures that the Owens tui chub habitat is unimpaired and hatchery operations are not affected by PLES I.

If monitoring of the wells, or any other data, indicated changes induced by PLES I operations were actually threatening or impacting the beneficial uses of thermal water, temporary and then permanent reservoir management techniques would be employed, with reduction or discontinuation of geothermal fluid production the ultimate reservoir management technique. Again, the selection of the proper reservoir management technique or techniques to implement (from those listed, or others, as appropriate) would depend upon the nature of the threat or impact to the beneficial uses of the thermal water.

If the authorized officer determines from the monitoring of the three monitoring wells that a progressive temperature or pressure change is occurring that threatens a change of temperature at the Hot Creek hatchery, or threatens the continued existence of the Owens tui chub, or that there is a threat to the Hot Creek Headsprings from project operations, then Pacific Energy would be required to supply an alternate source of thermal energy or water to the Hot Creek headsprings, and maintain the supply for as long as this alternative source was necessary. The following methods are some of the technically feasible means of supplying more heat or thermal water to the hatchery springs:

- heat the headsprings water with an external source of heat, such as a combined solar/fossil fuel (propane, etc.) or geothermal (through a heat exchanger) heater;
- supply PLES I Project geothermal production or injection fluid directly to the headsprings via a pipeline;
- drill a new, dedicated geothermal well in the vicinity of the hatchery headpsrings and deliver the fluid into the headsprings; or
- obtain geothermal fluid from the Mammoth Chance Project and pipe it to the headsprings.

If the thermal component of the hatchery headsprings increased so that the water was too hot, the following methods are some of the technically feasible means of cooling down or supplying cold water to the hatchery springs:

- cool the headspring water with an evaporative or dry (air) chiller or other cooling system;
- cycle water from Mammoth Creek immediately upstream of the confluence with Hot Creek to the headsprings;
- recycle water from Hot Creek as it leaves the hatchery back to the headsprings.

As noted in Section 4.1.4.3.1, it is considered exceedingly remote that pressure in the hydrothermal reservoir would rise, which could result in increased temperatures of the Hot Creek headsprings. The very small pressure increase predicted by the model occurs because the model assumes complete hydrologic communication between the production and injection reservoirs. In reality, it is unlikely that there is such complete communication. Therefore, although no detectable impact is expected, of the two possibilities, a decrease in the thermal component is the more likely.

Effectiveness/Impact:

STEP 1: No impact would result from this measure. Well SF 65-32 has already been drilled, and continued monitoring will have no discernable impacts.

STEP 2: The potential impacts of drilling another monitoring well would be similar in nature, but smaller in magnitude, than those from the drilling of a single geothermal well. The actual location of the well would be selected using the same criteria used to select the locations of the geothermal wells to ensure that potential impacts to case during the drilling of existing monitoring well SF 65-32. Existing disturbed areas would be used if possible. Temporary impacts to less than one acre of land around the

surface resources would be minimized to insignificance, as was the wellhead would be created. Mitigation measures proposed or stipulated for the drilling of the project geothermal wells would be implemented to ensure that the impacts during the short drilling time are insignificant. Because the well would not be flow-tested into a pit, nor would the well be connected to any power plant via a pipeline, the potential for any impacts related to the geothermal fluid are negligible. Much of the small amount of disturbed surface area could be reclaimed after drilling, although access would have to be maintained throughout the life of the well for continued monitoring and maintenance.

STEP 3: Monitoring of the hydrologic data would create no new impacts. Implementation of the reservoir management techniques would have beneficial impacts on the geothermal reservoir. Changing fluid volumes, discontinuing use of a well, or changing the depth of injection would not have an adverse effect on surface resources, and could have a positive effect on surface resources if a well or pipeline were abandoned and the surface properly reclaimed, as described in this chapter. If it were necessary to drill one or more new injection or production wells, the impact of each of these operations would be as described and analyzed in this chapter, and the measures required to mitigate these potential impacts to insignificance would be that same as also described in this chapter. The site(s) for any new well(s) would be selected to ensure that impacts are insignificant.

STEP 4: The impacts of drilling a third monitoring well, and the measures to mitigate potential impacts to insignificance, are identical to those described above in the discussion of STEP 2.

STEP 5: The impacts of this step, and the mitigation measures available to ensure mitigation of the potential impacts to insignificance, are the same as those described above under STEP 3.

STEP 6: Each of the suggested methods for applying thermal energy or water to the Hot Creek headsprings is technically feasible, but each would have some potential for creating associated environmental impacts. Mitigation measures can be applied which would ensure that the magnitude of the impacts is small.

One of the simplest means of supplying additional thermal energy to the Hot Creek headsprings is to apply an external heating source to the water flow of the headsprings. The previously prepared Environmental Assessment/Environmental Impact Report for the PLES I Project estimated the cost of fuel for replacing all the heat in the headsprings which could be lost at approximately $500,000 annually, a worst-case estimate. However, through the combination of a solar heating/storage system and a fossil fuel supplemental heater, the fuel cost of replacing the lost heat would be substantially reduced. The fossil-fuel burning heater would produce air quality impacts (nitrogen oxides, carbon dioxide, carbon monoxide, particulates, etc.) which would depend upon the fuel consumed and the specific burner chosen, and would require the approval of the Great Basin Unified Air Pollution Control District. However, the potential air emissions can be controlled, as necessary, to non-significant levels and ensure conformance with the District's regulations. In contrast, a solar heating system would produce no similar air quality impacts, but could be visually intrusive, especially if the system used highly reflective solar collectors. Proper selection, placement, and screening of the solar heating system components should ensure that visual impacts are not significant.

Diverting geothermal production or injection fluid from the PLES I or Mammoth Chance wellfields to supply additional thermal fluid or water to the Hot Creek headsprings could further deplete the geothermal resource in these areas, although it is likely that through the application of selected reservoir management techniques, the transfer of this geothermal fluid could be managed so that it does not adversely impact the temperatures or pressures of the geothermal reservoir under the Hot Creek headsprings. The amount of PLES I geothermal injection fluid necessary to compensate for the maximum (worst-case) thermal component of the headsprings flow which could be lost would be about 930 gpm, slightly less than 20% of the 5,000 gpm which would be produced (and injected) for the PLES I Project. Supplying the same amount of heat from a dedicated PLES I Project or Mammoth Chance Project geothermal production well would require about 480 gpm of geothermal fluid because it would be hotter. In either case, the amount of heat extracted from the commercially developed geothermal reservoir(s) and introduced

into the Hot Creek headsprings would be substantially less than that considered, and judged insignificant, in Section 4.1.4.3.6 (Cumulative Analysis) of this EIS/SEIR for the operation of any of the other geothermal projects. Some additional field exploration work may need to be conducted in the vicinity of the hatchery prior to the drilling of a new, dedicated well since the existence of the source geothermal reservoir in this immediate area has not yet been completely confirmed. However, the existence of the thermal component in the headsprings strongly suggests that a geothermal reservoir is located there.

Drilling additional wells (whether PLES I production or injection wells, Mammoth Chance geothermal wells, or shallow coldwater wells) could have temporary impacts on a variety of resources, much as described in this EIS/SEIR for wells drilled for the proposed project. However, these impacts would be very similar to those identified and analyzed by this document for the drilling of the project wells. Mitigation of these potential impacts would entail the implementation of the same measures as proposed in the project description and this document for pipelines and wells. Most impacts would be temporary (such as noise, visual intrustion, etc.), and could be substantially reduced by proper siting (to take advantage of natural screening by vegetation and topography) and scheduling to avoid those periods known to be potentially sensitive to certain resources (deer, songbirds, etc.).

Although pipelines for carrying geothermal water to the headsprings could be visible and would present the danger of spills, the measures presented in this chapter for the PLES I Project can reduce the potential impacts of these pipelines to insignificance. Geothermal fluid pipelines from the PLES I Project area to the Hot Creek headsprings could be routed along either the existing road system (Hot Springs Road and U.S. 395) to the headsprings or a more direct path. Potential visual impacts of the pipeline could be greatly reduced by siting so that natural vegetation and terrain provide visual screening, revegetating disturbed areas as soon as practical, and painting natural or neutral colors, and other measures. In addition, it could be possible to place significant portions of the pipeline(s) below grade, as the terrain may be more suitable for trenching and the temperature of the transported geothermal fluid may be substantially lower than that conveyed in the PLES I geothermal production pipelines.

The potential for geothermal fluid spills, which could reach Mammoth Creek and potentially cause environmental impacts, can be greatly reduced through the installation of automatic check valves at regular intervals along the line, high/low-pressure cutoff sensors, and low-pressure transfer pumps. The operator would also be required to regularly test, maintain, and inspect emergency shutdown systems, and may be required to develop and maintain a spill contingency plan. Any spill which, despite all the precautions, did occur would likely produce substantially less severe impacts to Mammoth or Hot Creek than from a spill from the PLES I Project operations if there were no spill containment features. This is because the amount of geothermal fluid which could spill from the pipeline is substantially less than (only 10 to 20%) of that which could spill from the PLES I Project; because the temperature of the fluid which could spill would likely be substantially less than that of the PLES I geothermal production wells; and because the pipeline could be located at a greater distance from the creek, which would result in more fluid infiltrating and not reaching the creek.

Should the temperature of the Hot Creek headsprings increase instead of decrease (which, as stated above, is unlikely), cooling could be accomplished by an evaporative cooling system for some of the outflow of the headsprings, or by the use of dry, or non-evaporative cooling, much like the system proposed for the PLES I Project cooling system. Besides consuming some of the water, the evaporative cooling system could be visually intrusive because of its height and blocky silhouette, and would occasionally produce water-vapor plumes which would be highly visible. In contrast, although somewhat less energy efficient, dry (air) cooling towers have a lower profile and do not produce visible plumes. Visual impacts from the implementation of this method could be reduced to insignificance through the careful painting and placement of the coolers to take advantage of the hatchery facilities already constructed in the near vicinity.

Pumping cold water from the shallow, cold groundwater aquifer in the vicinity of the hatchery into the headsprings could cool heated spring flows sufficiently, but could also affect natural flow of spring water at the headsprings. In contast to the very limited shallow groundwater aquifer system found in the immediate vicinity of

the Casa Diablo project area, the groundwater system in the vicinity of Hot Creek Hatchery contributes significantly to the surface water flows of Mammoth and Hot Creeks downgradient of the hatchery. One or more shallow groundwater wells placed downgradient of the fish hatchery would be able to intercept a small portion of this cold groundwater flow and add it to the headsprings, which ultimately discharge into Hot Creek, the same surface water that would normally receive the groundwater flow.

Cycling water from Mammoth Creek, upstream of its confluence with Hot Creek, could also be used to cool the flow of the headsprings without any consumptive use of the water. However, this technique could introduce other organisms into the refugia which might compete or otherwise adversely affect the Owens tui chub currently occupying the water. One means of avoiding this potential problem is to cycle the water to a closed system through the refugia upstream of the hatchery intake weirs, then discharge the water into the hatchery. Recycling of the outfall water of the hatchery itself would also be a technically feasible means to cool the headsprings water. However, the hatchery outfall water typically contains significant levels of biological oxygen demand (BOD) and nitrogen, among other substances which degrade water quality, which are normally discharged into Hot Creek. These products of the intensive aquaculture that is conducted at the hatchery could adversely affect both the Owens tui chub and the trout raised by the hatchery if allowed to accumulate/concentrate, and care would need to be taken to avoid adverse effects.

In summary, the revised hydrologic monitoring/mitigation plan as recommended above would monitor the geothermal reservoir and provide for implementation of reservoir management techniques and other mitigation measures in a progressive fashion in order to protect the beneficial uses of the geothermal resource. It is extremely unlikely that implementation of Step 6 would ever be necessary (see also mitigation, (7), below).

Impact: There could be delays in actually implementing the hydrologic monitoring or remedial action requirements, including supplying thermal energy or water to the hatchery area, if it were necessary to obtain necessary permits, engineer hardware, or design the system before proceeding.

Pumping cold water from the shallow aquifer could affect natural flow of spring water at the headsprings. Recycling water from Hot Creek could introduce other organisms into the refugia currently occupied by the Owens tui chub. Mitigations of these potential impacts would depend upon the measure(s) selected for cooling.

In summary, the monitoring/mitigation plan as recommended in mitigation (6) above would serve to monitor the production reservoir and allow for implementation of management techniques in a progressive fashion in order to protect the geothermal resource. It is overwhelmingly likely that implementation of Step 6 would never be necessary (see also mitigation (7), below).

Impact: The monitoring wells are designed to penetrate only the production reservoir, where fluid is being withdrawn. The behavior of the injection reservoir would be monitored only in the injection wells themselves.

Mitigation:

- See mitigation 6(c).

Effectiveness/Impact: The injection reservoir would be monitored. Temporary impacts from well drilling would occur.

Impact: There could be delays in actually supplying water to the hatchery area if it were necessary to obtain permits, install hardware, or undergo environmental review before proceeding.

Mitigation:

(7) Prior to commencing commercial geothermal operations, the operator shall prepare, and have approved by the authorized officer, a detailed program for timely implementing hydrologic monitoring or remedial action measures which may be

required through approval of these Plans of Operation. At a minimum, the program must include basic engineering designs, preliminary equipment fabrication and construction schedules, and permit or rights-of-way acquisition plans and schedules. The operator shall review and update the program annually, or as required by the authorized officer.

Effectiveness/Impact: This requirement would provide technical specifications for the potential future monitoring or contingency mitigation measures. The requirement would provide the BLM, and cooperating and consulting agencies, with additional information to ensure that potential monitoring or contingency mitigation measures could be required and implemented in a timely manner, as necessary.

Impact: Diminished value as a geologic interpretation site, due to reduction of spring flows at Hot Creek Gorge below measured background levels caused by PLES I operations.

Mitigation:

(8) Inject geothermal water into the geothermal reservoir upgradient of Hot Creek Gorge to offset reservoir pressure declines reducing spring flows.

Effectiveness/Impact: Pressure increases should restore spring flows and temperatures with time. The impacts of implementation of this measure would be the same as drilling any other well. See also Effectiveness/Impact discussion for Mitigation (6), above.

4.1.4.3.2 Alternative Location Impacts

The impacts due to production and injection for the Alternate PLES I site project are similar to that for the proposed project. The effect of increasing pumping from 5,000 to 6,000 gpm would have little effect on the pressure drawdowns, bulk model or heat balance calculations for effects on the reservoir. The result including PLES I and MP I are summarized below:

a) Pressure Response Calculation

Area	Predicted Pressure Response (psi) in Reservoir After 10 yrs.	20 yrs.	30 yrs.
Casa Diablo	+2.43	+2.43	+2.43
Hot Creek Hatchery	+0.61	+0.61	+0.61
Hot Creek Gorge	+0.43	+0.43	+0.43

The results, as expected, are similar to those for the proposed project showing predicted increases in average reservoir pressure in the three areas. The additional pumping for the alternative site causes pressure increases of approximately 9% greater than those calculated for the proposed project.

b) Bulk Model

Distance of Thermal Front from Casa Diablo		
After 10 yrs.	20 yrs.	30 yrs.
770 ft.	1080 ft.	1330 ft.

These results show only a very slight increase in distance traveled compared to that for the proposed project. See discussion in Section 4.1.4.3.1.

c) Heat Balance

	Predicted Temperature Change in Reservoir		
Area	After 10 yrs.	20 yrs.	30 yrs.
Casa Diablo	-3.2°C (-5.8°F)	-6.3°C (-11.3°F)	-9.5°C (-17.1°F)
Hot Creek Hatchery	-0.6°C (-1.1°F)	-1.3°C (-2.3°F)	-2.0°C (-3.6°F)
Hot Creek Gorge	0	0	0

The results are not significantly changed from those calculated for the proposed project. Effects on the hatchery spring flow and temperature are likely to be insignificant given the estimated at 2-3% thermal component of the springs (Sorey, 1976).

Mitigation: See mitigation (6) for the proposed project.

4.1.4.3.3 Smaller Power Plant Impacts

Impacts to the geothermal reservoir are likely to be similar to that for proposed PLES I including existing MP I. The reduction from estimated flow rate of 5000 to 3800 gpm is only 15% of the total flow required for operation of both PLES I and MP I, and the potential impact on the reservoir is not significantly lowered.

A summary of the analysis methods is given below:

a) Pressure Response Calculation

	Predicted Pressure Response (psi) in Reservoir		
Area	After 10 yrs.	20 yrs.	30 yrs.
Casa Diablo (65-32)	+2.0	+2.0	+2.0
Hot Creek Hatchery	+0.49	+0.49	+0.49
Hot Creek Gorge	+0.34	+0.34	+0.34

b) Bulk Model Calculation

Distance of Thermal Front from Casa Diablo		
After 10 yrs.	20 yrs.	30 yrs.
675 ft.	955 ft.	1170 ft.

c) Heat Balance Calculation

	Predicted Temperature Change in Reservoir		
Area	After 10 yrs.	20 yrs.	30 yrs.
Casa Diablo	-1.9°C (-3.4°F)	-3.8°C (-6.8°F)	-5.7°C (-10.3°F)
Hot Creek Hatchery	0	0	0
Hot Creek Gorge	0	0	0

These results are lower by approximately 7% compared to the proposed project.

Overall, the impacts on the geothermal reservoir are not significantly different from the proposed project.

See Appendix C and Section 4.1.4.3.1 for a discussion of calculation methods.

4.1.4.3.4 No-Action Alternative Impacts

Calculations were again performed to estimate impacts on the reservoir in the Hot Creek Hatchery and Hot Creek Gorge areas. Temperature and pressure effects are likely to be less for springs at the hatchery than in the subsurface. See Section 4.1.1.4 for a discussion of calculation methods and limitations.

a) Pressure Response Calculation (MP I only)

	Predicted Pressure Response (psi) in Reservoir		
Area	After 10 yrs.	20 yrs.	30 yrs.
Casa Diablo	+1.31	+1.31	+1.31
Hot Creek Hatchery	+0.30	+0.30	+0.30
Hot Creek Gorge	+0.21	+0.21	+0.21

b) Bulk Model (MP I only)

Distance of Thermal Front from Casa Diablo		
After 10 yrs.	20 yrs.	30 yrs.
480 ft.	680 ft.	830 ft.

c) Heat Balance (MP I only)

Area	Predicted Temperature Change in Reservoir After 10 yrs.	20 yrs.	30 yrs.
Casa Diablo	-1.2°C (-2.2°F)	-2.5°C (-4.5°F)	-3.7°C (-6.7°F)
Hot Creek Hatchery	0	0	0
Hot Creek Gorge	0	0	0

In summary, the threat of changes in the subsurface at the hatchery and Hot Creek Gorge is reduced by approximately 50% by the no-action alternative.

4.1.4.3.5 Abandonment and Reclamation

Use of the hydrothermal resource would cease with abandonment.

4.1.4.3.6 Cumulative Impacts

As indicated in the introduction, there are a number of geothermal and groundwater use projects in the vicinity that are proposed or may be proposed. Of these, five are considered planned to a point at which impacts may be estimated in addition to those for the PLES I project. These five projects are:

1)	MP I	7 MW
2)	MP II	10 MW
3)	MP III	10 MW
4)	Mammoth Chance I	10 MW
5)	Sandia/Santa Fe Deep Well	0 MW

The calculations were performed using the pressure response computer program referred to in Section 4.1.4.3.1. It assumes reservoir lateral communication and absence of recharge. Flowrates and startup dates were also assumed, details are given in Appendix C. The results provide a conservative (or reasonable worst-case) estimate of anticipated reservoir pressure response. Calculated responses due to operation of five power plants simultaneously are given below.

No production other than a short-term test is proposed for the Sandia/Santa Fe Deep Well project so it was not included in this analysis.

a) Calculated Pressure Response (psi)

Area	Predicted Pressure Response (psi) in a Reservoir After 10 yrs	20 yrs	30 yrs
Casa Diablo	+5.53	+5.53	+5.53
Hot Creek Hatchery	-1.88	-1.88	-1.88
Hot Creek Gorge	+0.30	+0.30	+0.30

These results are far more sensitive to placement of wells for the Mammoth/Chance project than for Casa Diablo area projects. Mammoth/Chance I well placements used here are those specified in the Mammoth/Chance I Final EA/EIR. Again, the results show that with all power plants operating at full capacity, a steady-state equilibrium would be reached after two years of operation. This result is due to the high porosity and 100% injection.

b) Bulk Model

The bulk model calculation is not easily adapted to a cumulative analysis involving injection in two widely separated areas. This is because a single uniform cylindrical front cannot be used to describe effects occurring 2-3 miles apart. The calculation was therefore performed for each area individually. Results for the Casa Diablo area include MP I, PLES I, MP II, and MP III acting simultaneously. Results for the Mammoth/Chance lease area include only Mammoth/Chance I.

Distance of Thermal Front from Injection Wells					
Casa Diablo			Mammoth/Chance		
After 10 years	20 years	30 years	10 years	20 years	30 years
980	1390	1700 ft.	850	1200	1475 ft.

Neither front is predicted to affect the hatchery or gorge springs.

c) Heat Balance

The same assumptions used for this calculation in Section 4.1.4.3.1 for MP I and PLES I also apply here with the additional production and injection for MP II, MP III and Mammoth/Chance I.

Area	Predicted Temperature Change in Reservoir After 10 yrs	20 yrs	30 yrs
Casa Diablo	-11.4°C (-20.5°F)	-21.1°C (-38.0°F)	-29.4° (-52.9°F)
Hot Creek Hatchery	-7.3°C (-13.1°F)	-14.2°C (-25.6°F)	-19.8° (-35.6°F)
Hot Creek Gorge	0	0	0

The temperature drawdown is much greater for the hatchery and Casa Diablo areas with all plants operating. However, based on the assumption that a 30°C (54°F) reservoir temperature decline may cause a 1°C (1.8°F) decline in the temperature at the hatchery spring flow, no significant impact is predicted.

A regional program for monitoring effects from existing and proposed geothermal power plants and other relevant projects has been developed by LVHAC and put into effect and, based on information obtained through monitoring programs required by the BLM, will provide guidelines for detection limits and trigger point limits which would initiate revised pumping plans, hatchery mitigation, and power plant shutdown. While monitoring will not, in and of itself, mitigate adverse cumulative impacts, it would provide an opportunity to identify hydrologic changes as they occur and would allow sufficient time for appropriate remedial mitigation measures to be implemented, if necessary.

4.2 BIOLOGICAL ENVIRONMENT

4.2.1 VEGETATION

4.2.1.1 Proposed Project Impacts

Impact: A loss of approximately 13 acres of sagebrush scrub and Jeffrey pine plant communities would occur from construction of the PLES I power plant, well fields, and pipelines. These estimates are based on site maps prepared by the project proponent and vegetation maps prepared by Taylor and Buckberg (1987). No botanically sensitive areas and no riparian areas would be directly impacted by the proposed project. The proposed project includes an extensive revegetation scheme, as described in Chapter 2 and Appendix B. It is possible that botanically sensitive rhyolite buckwheat areas could be damaged during construction activities near injection wells if equipment is driven outside designated areas.

The following measures are included in the proposed project to reduce impacts:

- During construction and operation of the facilities, care would be taken to avoid damaging existing vegetation whenever possible.
- Areas which are already disturbed would be utilized for laydown, storage, and construction activities. Only minimal damage to vegetation and soil would occur.
- Revegetation would be done as soon as practical.

Mitigation:

(9) Clearly mark limits of construction activity to avoid equipment vehicle travel outside construction area. Fencing may be required near sensitive areas.

Effectiveness/Impact: Inadvertant use of vehicles and equipment would not damage rhyolite buckwheat.

4.2.1.2 Alternative Location Impacts

Impact: A loss of approximately 15 acres of sagebrush scrub and Jeffrey pine plant communities would occur. The production pipelines would cross the sedge meadow northwest of Casa Diablo Geyser, disturbing about 2,400 square feet. No botanically sensitive area would be directly

affected by the production pipelines. The injection pipelines would cross botanically sensitive areas, disturbing about 9,000 square feet of rhyolite buckwheat scrub.

Mitigation:

- Reroute the main injection pipeline to the west of the dirt road which it would follow.

Effectiveness/Impact: Sensitive species and cultural resources could both be avoided by careful siting of the injection pipeline. The terrain may be slightly steeper west of the road, requiring more erosion control measures.

4.2.1.3 Smaller Power Plant Alternative Impacts

Impact: Approximately 12 acres of sagebrush scrub and Jeffrey pine plant communities would be cleared. No botanically sensitive areas would be directly affected. Otherwise impacts would be the same as for the proposed project.

Mitigation: No mitigation is recommended.

4.2.1.4 No-Action Alternative Impacts

Impact: No additional land would be cleared and the landscaping of the distrubed area across Hot Springs Road from MPI would not be done.

Mitigation: No mitigation is recommended.

4.2.1.5 Abandonment and Reclamation Impacts

Impact: Areas disturbed by project facilities would be recontoured and revegetated, as required by BLM regulations. Vegetation would in time return to its natural condition if revegetation efforts were successful.

Mitigation: No mitigation is recommended.

4.2.1.6 Cumulative Impacts

Impact: The Mammoth/Chance, Mammoth Pacific, and PLES I geothermal plants

would remove about 60 acres of sagebrush scrub, Jeffrey pine, Jeffrey pine/pinyon pine and mountain meadow plant communities. Exact acreages would be dependent on final site configuration. The Snow Creek, Sherwin Bowl and Juniper Ridge developments, which are at higher elevations than the geothermal plants, would impact coniferous forest and riparian plant communities in addition to sagebrush scrub and mountain meadows. Approximately 400 acres of these plant communities could be directly impacted by these developments. The Doe Ridge airport expansion may directly impact another 200 acres of sagebrush scrub.

If all of these projects are developed, approximately 700 acres (slightly more than one square mile) of natural vegetation would be cleared, much of it on Forest Service land. Of the 700 acres of vegetation cleared, a total of about 13 acres would be due to PLES I. If revegetation measures are successful, some of this acreage could be reclaimed. Adverse impacts to major widespread plant communities, such as sagebrush scrub, are not expected to be significant. Impacts from other projects to unique or uncommon plant communities, such as riparian corridors and thermal marshes, could be significant unless proper safeguards/mitigations are implemented.

Mitigation:

- Responsible agencies should require revegetation plans for all projects.

Effectiveness/Impact: Some vegetation would be restored. No further impacts would be expected from implementation of this measure.

4.2.2 TERRESTRIAL WILDLIFE

4.2.2.1 Proposed Project Impacts

Impact: A loss of up to 13 acres of sagebrush scrub and Jeffrey pine wildlife habitats is expected from construction of the power plant. These are widespread habitats in the area. Populations of pygmy nuthatches and hairy woodpeckers are not expected to be impacted, as fewer than 10 acres of Jeffrey pine habitat would be lost. No impacts to sage grouse populations are expected, as the area receives little sage grouse use and there are no nearby leks. No endangered, threatened, or other special status animal species are known to use the site. Thus, no significant impacts to populations of residential species are anticipated.

Mitigation: No mitigation is recommended.

Impact: Noise and human activity during construction and plant operation may reduce songbird density and may cause migratory deer to avoid the area but would not adversely affect songbird or deer populations. The impact on pygmy nuthatch and hairy woodpecker populations is not likely to be significant (Pacific Gas & Electric, 1986). The correlation between songbird density and noise levels has not been unequivocally demonstrated, so a definite effect cannot be predicted. Similarly, it is unclear to what extent deer are affected and no specific result can be anticipated with respect to deer populations and noise levels (Pacific Gas & Electric, 1986). The project proponent has adopted BLM measures limiting noise-intensive activities during deer migration periods.

Mitigation: No mitigation is recommended.

Impact: Approximately 70 deer were found to use the immediate Casa Diablo area during the spring 1987 migration (Kucera, T.E., 1987b and 1988). About 6,000 deer from the Casa Diablo, Sherwin Grade, and Buttermilk herds are potential users of the Casa Diablo area. The plant and pipelines may directly impede deer movement through the area, or pipeline configuration may funnel deer into impassable areas; however, deer move across a broad area in this flat terrain in contrast to the narrow, constrained corridors of the Sierra escarpment, and it is relatively easy for them to avoid obstruction in the project area (Kucera, T., 1987). Reports of deer jumping fences up to eight feet tall are common especially when the fence encloses well-watered vegetation (Sunset New Western Garden Book, 1979). It is therefore likely that some, or perhaps many, of the adult deer could jump single pipelines along most of their length. However, there is no information available on how effective a deterrent the pipeline would be to normal migration or what the effect would be on pregnant deer in the spring migration or young deer in the fall migration. It is possible that some deer would be adversely impacted. Does carrying fawn may be more vulnerable to stress from disruptions.

The proposed project includes limiting noise intensive activities during deer migration periods and trenching or burying sections of the pipeline as described in the revegetation plan. Ramps would be built across the trenches at the direction of the authorized officer to facilitate deer movements. All fencing must be approved by the authorized officer to ensure that it will not funnel deer into dead-end routes or direct them into inappropriate areas.

Mitigation: No mitigation is recommended.

Impact: There is no important habitat on-site for bald eagle, peregrine falcon, northern goshawk, Williamson's sapsucker, or yellow warbler in the project area. Thus no impacts to these species are expected from project development.

Mitigation: No mitigation is recommended.

4.2.2.2 Alternative Location Impacts

Impact: A loss of up to 15 acres of sagebrush scrub and Jeffrey pine wildlife habitats is expected from construction of this alternative. These are widespread habitats in the area. Populations of pygmy nuthatches and hairy woodpeckers are not expected to be impacted, as fewer than 10 acres of Jeffrey pine habitat would be lost. No impacts to sage grouse populations are expected, as the area receives little sage grouse use and there are no nearby leks. No endangered, threatened, or other special status animal species are known to use the site. Thus, no significant impacts to populations of residential species are anticipated.

Mitigation: No mitigation is recommended.

Impact: Noise and human activity during construction and plant operation may reduce songbird density and may cause migratory deer to avoid the area but would not adversely affect songbird or deer populations. The impact on pygmy nuthatch and hairy woodpecker populations is not likely to be significant (Pacific Gas & Electric, 1986). The correlation between songbird density and noise levels has not been unequivocally demonstrated, so a definite effect cannot be predicted. Similarly, it is unclear to what extent deer are affected and no specific result can be anticipated with respect to deer populations and noise levels (Pacific Gas & Electric, 1986). The project proponent has adopted BLM measures limiting noise-intensive activities during deer migration periods.

Mitigation: No mitigation is recommended.

Impact: Approximately 70 deer were found to use the immediate Casa Diablo area during the spring 1987 migration (Kucera, T.E., 1987b and 1988). About 6,000 deer from the Casa Diablo, Sherwin Grade, and Buttermilk herds are potential users of the Casa Diablo

area. The plant and pipelines may directly impede deer movement through the area, or pipeline configuration may funnel deer into impassable areas; however, deer move across a broad area in this flat terrain in contrast to the narrow, constrained corridors of the Sierra escarpment, and it is relatively easy for them to avoid obstruction in the project area (Kucera T., 1987). Reports of deer jumping fences up to eight feet tall are common especially when the fence encloses well-watered vegetation (Sunset New Western Garden Book, 1979). It is therefore likely that some, or perhaps many, of the adult deer could jump single pipelines along most of their length. However, there is no information available on how effective a deterrent the pipeline would be to normal migration or what the effect would be on pregnant deer in the spring migration or young deer in the fall migration. It is possible that some deer would be adversely impacted. Does carrying fawn may be more vulnerable to stress from disruptions.

The alternate power plant location in combination with the existing MP I power plant would have a greater impact on deer using the Casa Diablo area than if the power plant sites adjoined (Kucera, 1987). This is because a larger area would be affected by the alternative location.

Mitigation:

- Require burial, trenching, and use of ramps at pipelines to facilitate deer movement.

Effectiveness/Impact: Impacts to deer would be less than if no lines were buried or trenched..

Impact: There is no important habitat on-site for bald eagle, peregrine falcon, northern goshawk, Williamson's sapsucker, or yellow warbler. Thus no impacts to these species are expected from project development.

Mitigation: No mitigation is recommended.

4.2.2.3 Smaller Power Plant Impacts

Impacts to wildlife from the smaller power plant alternative would be effectively indistinguishable from the proposed project. See Section 4.2.2.1.

4.2.2.4 No-Action Alternative Impacts

No impacts to wildlife would occur from the no-action alternative.

4.2.2.5 Abandonment and Reclamation Impacts

Impact: Grading and recontouring would increase human activities, but when reclamation were complete, the habitat value of the project site would be regained.

Mitigation:

- The abandonment plans shall have provisions for monitoring revegetation. The revegetation shall have as its goals establishing habitat value equivalent to the scrub and forest vegetation in the area and controlling erosion.

4.2.2.6 Cumulative Impacts

Impact: Habitat removal of up to 400 acres of forest could impact goshawks, pygmy nuthatch, and hairy woodpeckers, due to loss of foraging and nesting areas when timber, including snags, is harvested.

Mitigation:

- Minimize timber harvesting for all projects.

Effectiveness/Impact: Impacts to habitat would be slightly diminished. No further impacts to other resources would be anticipated.

Impact: Cumulative impacts to local deer herds are potentially significant. While summer and winter ranges would be largely unaffected, deer migration routes, which are a vital link in deer ecology, could be disrupted by the proposed projects. The proposed projects and alternatives are within the potential migration routes of the Buttermilk, Sherwin Grade, and/or Casa Diablo deer herds. Disruption of migration would lead to a decline in deer populations which, while currently stable in the region, are more generally on a downward trend..

Mitigation:

- New projects should contribute to off-site mitigation measures proportional to their relative impacts on deer:

- Cumulative impacts to the deer herds could be mitigated by regulating and limiting development in areas of known migration routes and/or acquisition of critical habitat in migration and winter range areas, such as Swall Meadow. Swall Meadow, located approximately 18 miles southeast of Casa Diablo, has been identified as an extremely critical deer resource area in that both the Buttermilk and Sherwin Grade deer herds spend the winter there. Protection of this area through acquisition by the BLM, Forest Service, state, county, or a conservation organization would provide significant protection of winter range for those herds.

- Water availability on summer and winter ranges was specifically identified as a factor limiting the size of the Casa Diablo herd (T. Taylor, 1988). Construction of permanent artificial watering sources was suggested as a specific means for improving water-scarce portions of deer range and could also serve as a valuable off-site mitigation measure.

Effectiveness/Impact: The precise effectiveness of either mitigation is difficult to predict, but each measure would address an identified source of pressure on the deer population.

4.2.3 AQUATIC RESOURCES

4.2.3.1 Proposed Project Impacts

Impact: Should the spill containment plan and all erosion control measures completely fail, increased sedimentation in Mammoth and Hot Creeks may result. Elevated turbidity levels would clog and irritate gill structures and impair respiration, feeding, and swimming capabilities of resident fish and aquatic invertebrates. Erosion control measures proposed as part of the project in combination with the spill containment basins would likely eliminate the risk of this happening (see Section 4.1.2.2.1).

Mitigation: No mitigation is recommended.

Impact: Organic compounds which would be used during drilling, construction, or operation could spill and contaminate local waters. Paint, diesel fuel, lubricating oils, and small quantities of solvents would be stored and used on-site. These compounds are toxic in low concentrations and would cause adverse effects to aquatic resources if any leakages or spills occur into Mammoth Creek. To reach Mammoth Creek spills would have to escape from the bermed project area, flow over the surface for a distance of 100 to 1,500 feet to the intermittent stream bed, then travel approximately 0.6 mile.

Permit requirements of the Lahontan Regional Water Quality Control Board should suffice to mitigate this potential impact by the requirement that all paints, fuels, lubricants, solvents, or other compounds potentially harmful to aquatic organisms be stored in secure containers within bermed areas so that leaks would be contained.

The project includes the installation and operation of emergency spill containment basins as well as sedimentation basins during construction to help decrease to insignificant levels the potential of any spill adversely affecting surface aquatic resources.

Mitigation: No mitigation is recommended.

Impact: If the geothermal production pipelines supplying the power plant should rupture, pressure would suddenly drop, alarms would sound in the plant, isolation valves in the pipelines would close, and the wells would be shutdown automatically within less than one minute. Assuming a worst-case scenario that the largest pipeline had ruptured, 5,000 gpm of superheated geothermal fluid would be released for five minutes. Approximately 25,000 gallons of 200°F fluid would be released during that period. (Approximately 15% of the fluid would flash to steam as the elevated fluid pressure drops to atmospheric pressure). If all automatic shutdown controls failed, the pumps and isolation valves could be shutdown from the plant control room within two to three minutes. Should all electricity fail, pumps would stop and valves would shut automatically. In addition, all pumps and valves could be closed manually by plant personnel within five munites. If none of the released fluid infiltrated into the soil, it would flow via the intermittent streambed and then to the spill containment structures. The containment structures have a total capacity of approximately 1.7 million gallons or 68 times the volume of the

worst-case pipeline rupture. It is therefore unlikely that this fluid would ever reach Mammoth Creek. The temperature of water reaching Mammoth Creek if the spill containment basins were to rupture has been estimated (see Section 4.1.4.1.1) for two cases. For the first case, assuming high stream flow of 50°F water, the mixed geothermal fluid / stream water would be at a temperature of 60°F. This would not pose a threat to any aquatic organisms. The second case assumes very low stream flow, in which case the mixed water would have a temperature perhaps as high as 118°F. This would cause mortality in trout as long as the water temperature remained above about 80°F. A bioassay of the geothermal fluid conducted by the CDFG in April 1988 apparently indicates that geothermal fluids spilled into Mammoth Creek would not be acutely toxic to aquatic organism (Mono County Energy Management Department 1988 [in MP II EIR Addendum]). A bioassay would be required under the revised Plan for Baseline Data Collection.

If project operations caused mortality to fish in Mammoth Creek, Pacific Energy has agreed to fund restocking of the affected stream reach.

Mitigation:

(10) Implement and maintain the emergency spill containment plan.

Impact: If production of geothermal fluid at the proposed project does, contrary to predicted results, cause a change in the temperature or amount of thermal water reaching Hot Creek Hatchery, its operations could be adversely affected. However, implementation of the mitigation measures required by the BLM and Forest Service of the PLES I project are considered sufficient to reduce the potential for significant impacts to insignificance. See Section 4.1.4.3.1 for a discussion of impacts of the proposed project on hydrothermal resources and the measures included in the project to reduce impacts.

Mitigation: See mitigations (6), (7), and (8) in Section 4.1.4.3.1, Hydrothermal Resources.

4.2.3.2 Alternative Location Impacts

The power plant at the alternative site would employ the same emergency shutdown procedures as described for the proposed project in Section 4.2.3.1. Assuming an worst-case scenario,

approximately 60,000 gallons of 200°F fluid would be released. It is possible that this fluid could reach the ephemeral lakes northwest of the plant, but it is highly unlikely any of this spilled fluid would reach Mammoth Creek because of the emergency spill containment structure.

A significant amount of cooling and percolation would be likely to occur as the fluid traveled approximately one mile to the basin. Cooling and percolation may reduce temperature and flow to effectively compensate for the additional 1,000 gpm which would be required to run the power plant at the alternative site. Impacts of emergency spill containment failure would be the same as for the proposed project.

4.2.3.3 Smaller Power Plant Alternative Impacts

Impacts to aquatic resources would be substantially the same as for the proposed project.

4.2.3.4 No-Action Impacts

Impact: A major spill from MP I could reach Mammoth Creek in the absence of spill containment basins, which would be built as a result of the PLES I project. See discussion in Section 4.1.4.1.

Mitigation:

- Appropriate agencies should require spill containment facilities to protect Mammoth Creek from spills.

Effectiveness/Impact: Aquatic resources in Mammoth/Hot Creeks would be protected.

4.2.3.5 Abandonment and Reclamation Impacts

Impact: No serious impacts to aquatic resources would occur. See Sections 4.1.2.2.5 under Soils and Erosion, and 4.1.4.1.5 under Surface Water Quality.

Mitigation: No mitigation is recommended.

4.2.3.6 Cumulative Impacts

Impact: The proposed spill containment facilities would protect the entire Casa Diablo geothermal development area, so it is not believed that the cumulative potential for spills from the proposed geothermal projects in the Casa Diablo area represents a potentially significant impact, regardless of potential impacts of other development.

Mitigation: See mitigations recommended in Section 4.1.2.2.6 under Soils and Erosion.

Impact: Known refugia of Owens tui chub would not be affected by the geothermal plants near Casa Diablo. However, it is possible that shallow groundwater flows and the water quality of surface runoff near the refugia could be affected by the Mammoth/Chance geothermal projects, the Doe Ridge project, or by increased water use by the Town of Mammoth Lakes. In addition, any upgradient development in the Mammoth Creek basin which would significantly decrease groundwater recharge of the area could indirectly impact the chub by changing the characteristics of the springs supplying the critical chub habitat to a level beyond their adaptability. The Owens tui chub will be protected pursuant to stipulations rendered by a biological opinion to be prepared by U.S. Fish and Wildlife Service as specified by Section 7 of the Endangered Species Act.

Mitigation: No mitigation is recommended.

4.3 SOCIAL ENVIRONMENT

4.3.1 CULTURAL RESOURCES

4.3.1.1 Proposed Project Impacts

Impact: Potential adverse impacts to cultural resources sites in the project area may be of two kinds: direct and indirect. Direct adverse impacts would be expected if construction of the proposed facilities altered the location of, or destroyed, cultural resources or areas traditionally used by Native American groups. Indirect adverse impacts are less clear-cut and can be expected to occur beyond the actual spatial confines of direct impact during construction and

operation. Indirect adverse impacts may affect any cultural resources in the general vicinity of proposed geothermal development. An example of indirect impact to cultural resources would be collection of artifacts by construction and operation personnel.

Mitigation:

(11) A focused program of educating project personnel to develop an awareness of the surrounding cultural environment and the need to leave any cultural remains as they are found in the environment should be implemented to mitigate indirect impacts on cultural resources.

Effectiveness/Impact: If the program were successful, artifacts would be protected; otherwise, it might serve to make personnel more aware of the presence of artifacts and promote their collection. No other impacts would result from implementation of this measure.

Direct Impact: Cultural Resource Site-1 (see Section 3.3.1) is locate immediately east of the proposed power plant site. All injection wells except SFI 44-32 are likely to be within Cultural Resource Site-1. This site has been tested for significance through a formal program of systematic data recovery (Hall, M.C., 1986). Results from this investigation have provided useful scientific data indicating a non-intensive, but recurrent, prehistoric occupation and use of the site over several thousand years.

Consultation with the State Historic Preservation Officer (SHPO) has taken place and a no-effect determination has been made.

Mitigation: None is necessary.

Direct Impact: The injection pipeline would pass immediately adjacent to Cultural Resource Sites-7, -8, and -9. Careless use of equipment during laying of the pipeline could damage those sites.

Mitigation:

(12) Designate the pipeline route with stakes and flagging before installation of the pipeline begins.

Effectiveness/Impact: The sites would be protected from inadvertant damage. No further environmental impact would result from implementation of this measure.

Direct Impact: It is possible that subsurface cultural resources may be encountered during construction. If subsurface cultural resources were encountered during construction activities, standard geothermal lease stipulations regarding cultural resources would be followed.

Special Stipulation No. 3, of Geothermal Lease #11667 Antiquities and Cultural Values, reads as follows:

"Prior to beginning any operations other than casual use as defined in 43 CFR 3209.0-5(d), the lessee shall furnish to the Forest Service and the DCM for Geothermal, an archaeological report prepared by a qualified archaeologist acceptable to the Forest Supervisor, which clears the proposed sites if no cultural values exist; or if cultural values are found on any of the proposed site, makes recommendations for the collection of the values, avoidance (relocation of the sites), or other mitigation measures. The Forest Supervisor will review these plans, and in consultation with the lessee, determine an appropriate course of action. All mitigation shall be completed prior to beginning operations which would disturb the cultural values. The responsibility and cost for survey and mitigation shall be borne by the lessee. All such work shall be conducted under authority of a Forest Service Antiquities Permit and be subject to the provisions and stipulations contained therein, as well as all pertinent Federal Historic Preservation mandates and guidelines.

Should previously unknown objects of cultural, historic, or scientific artifacts and paleontological specimens be discovered during the course of operations, all activity in the affected area shall cease. The lessee shall leave all such material in place and contact the Forest Supervisor and the DCM for Geothermal immediately. Operations in the area shall not recommence until approved by the Forest Supervisor and the DCM for Geothermal."

Mitigation: No mitigation is recommended.

Indirect Impact: The Native American Bishop Elders voiced concerns about proposed geothermal development in areas where they have traditional Native American interests (Reynolds, L., 1987). Such interest include use of hot springs in the region for ritualistic purposes, the collection of special plants which grow near the hot springs, and the collection of a special type of soil which occurs near the project area. Although no specific sites near the proposed project have been identified as sacred by Native Americans, Pacific Energy has indicated that continued access to traditional Native American camping and collecting areas would be provided. As such, Native Americans would have continued access to their traditional use areas. This access will be required by the BLM.

Mitigation: No mitigation is recommended.

4.3.1.2 Alternative Location Impacts

Impact: Potential adverse impacts to cultural resources sites in the general vicinity of the project may be of two kinds: direct and indirect. Direct adverse impacts would be expected if construction of the proposed facilities altered the location of, or destroyed, cultural resources or areas traditionally used by Native American groups. Indirect adverse impacts are less clear-cut and can be expected to occur beyond the actual spatial confines of direct impact during construction and operation. Indirect adverse impacts may affect any cultural resources in the general vicinity of proposed geothermal development. An example of indirect impact to cultural resources would be collection of artifacts by construction and operation personnel.

Mitigation: See mitigation (11) for the proposed project.

Direct Impact: All injection wells except SFI 44-32 are on Cultural Resource Site-1. This site has been tested for significance through a formal program of systematic data recovery (Hall, M.C., 1986). Results from this investigation have provided useful scientific data indicating a non-intensive, but recurrent prehistoric occupation and use of the site over several thousand years.

Hall (1986) does not consider the site to be eligible for nomination to the National Register of Historic Places because no additional information is likely to be obtained from further data recovery. Eligibility would be determined upon consultation with the State Historic Preservation Officer (SHPO).

Mitigation: None is necessary if SHPO determines the site is not eligible for the National Register of Historic Places.

Effect/Effectiveness: If SHPO concurs with the assessment of no eligibility, there would be no adverse impacts to cultural resources at Cultural Resource Site-1. If the SHPO does not concur with the assessment that site Cultural Resource Site-1 is not eligible for the National Register of Historic Places, then a mitigation program acceptable to the SHPO should be developed by the project proponent, in coordination with the Inyo National Forest Archaeologist, as required by special stipulation to the geothermal lease.

Direct Impact: The injection pipeline would pass immediately adjacent to Cultural Resource Sites-7, -8, and -9. Careless use of equipment during laying of the pipeline could damage these sites.

Mitigation:

- Designate the pipeline route with stakes and flagging before installation of the pipeline begins.

Effectiveness/Impact: The sites would be protected from inadvertant damage. No further environmental impact would result from implementation of this measure.

Direct Impact: It is possible that subsurface cultural resources may be encountered during construction. If subsurface cultural resources were encountered during construction activities, standard geothermal lease stipulations regarding cultural resources would be followed.

Special Stipulation No. 3, of Geothermal Lease #11667 Antiquities and Cultural Values, reads as follows:

> "Prior to beginning any operations other than casual use as defined in 43 CFR 3209.0-5(d), the lessee shall furnish to the Forest Service and the DCM for Geothermal, an archaeological report prepared by a qualified archaeologist acceptable to the Forest Supervisor, which clears the proposed sites if no cultural values exist; or if cultural values are found on any of the proposed site, makes recommendations for the collection of the values, avoidance (relocation of the sites), or other mitigation measures. The Forest Supervisor will review these plans, and in consultation with the lessee, determine an appropriate course of action. All mitigation shall be completed prior to beginning operations which would disturb the cultural values. The responsibility and cost for survey and mitigation shall be borne by the lessee. All such work shall be conducted under authority of a Forest Service Antiquities Permit and be subject to the provisions and stipulations contained therein, as well as all pertinent Federal Historic Preservation mandates and guidelines. Should previously unknown objects of cultural, historic, or scientific artifacts and paleontological specimens be discovered during the course of operations, all activity in the affected area shall cease. The lessee shall leave all such material in place and contact the Forest Supervisor and the DCM for Geothermal immediately. Operations in the area shall not recommence until approved by the Forest Supervisor and the DCM for Geothermal."

> Mitigation: No mitigation is recommended.

Indirect Impact: The Native American Bishop Elders voiced concerns about proposed geothermal development in areas where they have traditional Native American interests (Reynolds, L., 1987). Such interest include use of hot springs in the region for ritualistic purposes, the collection of special plants which grow near the hot springs, and the

collection of a special type of soil which occurs near the project area. Pacific Energy has indicated that continued access to traditional Native American camping and collecting areas would be provided. As such, Native Americans would have continued access to their traditional use areas. This access will be required by the BLM.

Mitigation: No mitigation is recommended.

4.3.1.3 Smaller Power Plant Impacts

Impacts of this alternative would be the same as those of the proposed project.

4.3.1.4 No-Action Alternative Impacts

Cultural resources would be unaffected by project activities.

4.3.1.5 Abandonment and Reclamation Impacts

There would be no additional direct impacts to cultural resources due to abandonment and reclamation beyond those caused by the original construction of the project.

Impact: Indirect impacts could result from having workers on the site who might collect artifacts.

Mitigation: See mitigation (11) in Section 4.3.1.1.

4.3.1.6 Cumulative Impacts

Impact: Five geothermal power generation plants of similar size either exist or are proposed for the area impacting a total area of about 75 acres. Their cumulative adverse impacts would be greater than for any one project. These impacts include, but are not limited to, cultural resource site disturbance and/or total destruction. As development of the region increases, it will become more difficult to relocate construction sites and access roads to avoid potential adverse impacts to identified cultural resources. In turn, the only alternative that would remain is a comprehensive, systematic data recovery plan of these cultural resources sites and this, in and of itself, results in the ultimate

destruction of the site. Additional proposed projects would disturb approximately 1,000 acres. Without a program of identification of the cultural resources existing within the entire project vicinity, it can be assumed that some type of disturbance and/or destruction of cultural resources will occur. Cultural remains are non-renewable resources and the incompatibility of these sites and proposed geothermal development will remain a significant factor within the area.

Mitigation:

- Upon the preliminary siting of future facilities, an on-site inspection, evaluation, and mitigation of any identified areas of cultural resource significance should be made mandatory prior to the commencement of construction activities.

Effectiveness/Impact: Some measure of protection would be provided cultural resources. No further impact would be expected.

Indirect Impact: Native American access to areas where they have traditional interests could be limited by more intensive geothermal development.

Mitigation:

- Require operations of geothermal projects to allow Native Americans continued access to visit hot springs and to collect special soil and plants from the areas.

Effectiveness/Impact: Native American values with respect to hot springs and their associated soils and vegetation would be protected. No further impact would be expected.

4.3.2 RANGE RESOURCES

4.3.2.1 Proposed Project Impacts

Impact: Occupation at the proposed site by permanent facilities would remove approximately 7.5 acres of range land from the grazing allotment. The power plant facilities would be fenced, preventing access to the land. An additional 5.5 acres would be cleared of all vegetation but would be available for revegetation once site occupation was completed. The 13 acres of range initially cleared and occupied represents a loss of approximately two AUMs to the permittee.

If the entire well field and power plant area were unavailable to the grazing permittee (due to pipeline configuration and adjacent fencing on private land), approximately 33 acres of range land would be unusable. This acreage is equal to approximately 5.5 AUMs of grazing output and would not significantly affect the
current lessees operations.

The project includes revegetation of all nonoccupied cleared areas with vegetation suitable for grazing. Approximately 50% of the anticipated range loss could be recovered over time if revegetation efforts are successful.

Mitigation: No mitigation is recommended.

4.3.2.2 Alternative Location Impacts

Impact: The alternative location would remove about 15 acres from the grazing allotment, instead of 13 acres removed by the proposed project. Otherwise, impacts would be the same as for the proposed project.

Mitigation: No mitigation is recommended.

4.3.2.3 Smaller Power Plant Alternative Impacts

Impact: The smaller power plant would remove about 12 acres from the grazing allotment. Otherwise impacts would be the same as for the proposed project.

Mitigation: No mitigation is recommended.

4.3.2.4 No-Action Alternative Impacts

Grazing would continue unchanged from present conditions:

4.3.2.5 Abandonment and Reclamation Impacts

Impact: If revegetation efforts were successful, the full range would be recovered after project abandonment.

Mitigation: No mitigation is recommended.

4.3.2.6 Cumulative Impacts

Up to 60 acres of land would be removed from use as rangeland by construction of PLES I, and MP II & III and Mammoth / Chance I. This represents approximately ten AUMs. Vegetation on up to 200 acres of grazeland could be disturbed at Doe Ridge. If the whole area were lost to grazing, it would represent an additional 30 AUMs.

4.3.3 RECREATIONAL RESOURCES

4.3.3.1 Proposed Project Impacts

Impact: If hydrologic analysis is correct there would be no impact to the thermal springs at Hot Creek Gorge. If thermal springs at Hot Creek Gorge were reduced or depleted as a result of operating the PLES I plant, it would be less valuable as a geologic interpretative site. There could be a loss of one of the many natural features which attract recreationists to the Mammoth area, including a loss of approximately 95,000 recreational visitor days per year at that site.

The trout stocking program in California would be adversely affected if year-round operation could not continue at Hot Creek Hatchery due to lowered temperatures. See the discussion on Aquatic Resources, Section 4.2.3.1, and Hydrothermal Resources, Section 4.1.4.3.

Mitigation: See mitigation (8) in Section 4.1.4.3.1.

Impact: If a spill of geothermal fluid resulted in significant fish mortality, fishing in Mammoth Creek would be temporarily adversely affected. The remote possibility of a spill reaching Mammoth Creek is described in Surface Water Quality, Section 4.1.4.1.1. Should operation of PLES I cause significant fish kills, as determined by the authorized officer, the operator will restock the affected fishery(s). A bioassay of the geothermal fluid conducted by the CDFG in April 1988 apparently indicates that geothermal fluids spilled into Mammoth Creek would not be acutely toxic to aquatic organisms (Mono County Energy Management Department, 1988, MP II EIR Addendum). A bioassay would be required under the revised Plan for Baseline Data Collection.

Mitigation: See mitigation (10) in Section 4.2.3.1.

Impact: There are no recreational facilities within the project area and other than cycling and jogging, no known recreational activities occur there. A relatively small number of recreationists travel east on Antelope Springs Road past the project area to utilize the unimproved dispersed recreation opportunities of Little Antelope Valley. Recreationists driving, cycling, and jogging near the project area may be affected by the noise of the facility, but recreational opportunities would not be affected.

Mitigation: No mitigation is recommended.

4.3.3.2 Alternative Location Impacts

Impact: There are no known recreational facilities within the area which would be used by the power plant at the alternative site and other than jogging and target shooting, no known recreational activities occur nearby. Those recreationists using the informal target shooting area or traveling further east into Little Antelope Valley would pass immediately north of the power plant and could hear and see the plant. Recreational opportunities would not be affected.

Mitigation: No mitigation is recommended.

4.3.3.3 Smaller Power Plant Impacts

Impacts would be the same as for the proposed project.

4.3.3.4 No-Action Alternative Impacts

Impact: No spill containment structure would be developed, so if a major geothermal fluid spill which occurred outside the bermed area or which escaped the berms and containment facilities on the power plant site, it is possible it could reach Mammoth Creek and damage the fishery. For a full discussion, see Surface Water Quality, Section 4.1.4.1.4 and Aquatic Resources, Section 4.2.3.4.

Mitigation: No mitigation is recommended.

4.3.3.5 Abandonment and Reclamation Impacts

Impact: Well-plugging and grading activities would cause temporary noise and dust which affect recreationists.

Mitigation:

- Apply the same dust and noise control measures as would be required during construction.

4.3.3.6 Cumulative Impacts

Impact: If the hydrologic analysis is correct, there would be no significant impact to thermal springs at Hot Creek Hatchery or Hot Creek Gorge from the combined production of MP I and the four proposed geothermal projects. For the full discussion, see Hydrothermal Resources Section 4.1.4.3.6. If the thermal springs at Hot Creek Gorge were reduced or depleted as a result of the operation of the geothermal power plants, it would be less valuable as a geologic interpretive site and could result in the loss of approximately 95,000 recreation visitor days per year of use at the site.

The trout stocking program in California would be adversely affected if year-round operation at Hot Creek Hatchery could not continue due to lowered temperatures.

Mitigation: See mitigations (7) and (8) in Section 4.1.4.3.1.

Impact: If a spill of geothermal fluid resulted in significant fish mortality, fishing in Mammoth Creek would be temporarily, adversely affected. The remote possibility of a spill reaching the creek is described in Surface Water Quality, Section 4.1.4.1.6.

Mitigation: No mitigation is recommended.

Impact: As the areas of geothermal are not visible from nearby tourist destinations (e.g., Shady Rest or Sherwin Creek Campgrounds, Little Antelope Valley, or Hot Creek Gorge) and the view near the site also encompasses other man-made features (e.g., power plant, multiple roads and electrical transmission lines, and gasoline and propane storage tanks), tourists are not likely to be deterred from visiting the area or to experience a less rewarding recreational experience because of the presence of the proposed geothermal power plants. The BLM/Forest Service approval of the project as earlier proposed found that the facility would be in keeping with the existing visual character and would not significantly alter the view in the local area.

Mitigation: No mitigation is recommended.

4.3.4 TIMBER RESOURCES

4.3.4.1 Proposed Project Impacts

Impact: Merchantable-size Jeffrey pine would be harvested during the clearing of injection well pads, and the eastern portion of the injection pipeline path (where necessary). A few merchantable trees are located on the power plant site. No merchantable-size trees would be harvested during the clearing of production well pads, production pipeline path, or western portion of the injection pipeline path. Where merchantable-size Jeffrey pine are present, timber volumes are estimated at 24,000 board-feet per acre. At this stocking level fewer than 40,000

board-feet would be harvested during the clearing for pipelines and well pads. These lands are not managed for timber production and are not included in the Inyo National Forest timber base.

An unknown number of smaller, nonmerchantable trees would be transplanted during the construction of all proposed facilities. These trees would be transplanted to the viewshed foreground and used to screen facilities.

Mitigation: No mitigation is recommended.

4.3.4.2 Alternative Location Impacts

Impact: The alternative power plant site has timber volumes estimated at 30,000 board-feet per acre. The longer injection pipelines pass through areas similarly forested. At those stocking rates, construction of this alternative would result in the harvesting of no more than 220,000 board-feet would be harvested.

Mitigation: No mitigation is recommended.

4.3.4.3 Smaller Power Plant Impacts

Impact would be the same as for the proposed project.

4.3.4.4 No-Action Alternative Impacts

No timber would be harvested.

4.3.4.5 Abandonment and Reclamation Impacts

Impact: Revegetation efforts would, in time, restore timber levels.

Mitigation: No mitigation is recommended.

4.3.4.6 Cumulative Impacts

Because the Mammoth/Chance development would require no timber harvest, the cumulative effects of geothermal development would be the additive effects of the PLES I and the MP II & III projects. A maximum of 303,000 board-feet could be harvested during clearing for the three mentioned power plant units. Timber volumes harvested from these lands could be used to either offset timber harvested in other sale areas or add to the forest timber target for any one year.

At Sherwin Bowl, up to 150 acres of timber would be cleared. Some timber would be harvested for the Juniper Ridge project as well. Depending on stocking levels and exact averages, these projects could result in the harvesting of perhaps as much as 6 million board-feet.

4.3.5 TRANSPORTATION AND SITE ACCESS

4.3.5.1 Proposed Project Impacts

Impact: Transportation and access to the project site would not be problem most of the year. Seasonally heavy traffic utilizing the north-bound offramp from Highway 395 to Route 203 and the Mammoth Mountain ski areas could become congested if peak project construction traffic coincides. However, it is unlikely that peak construction activity would occur during either winter months or during weekend peak traffic periods. During seasonal weekend peak traffic periods, construction traffic would be routed to Hot Springs Road (Old Highway 395) and the project site from the Sherwin Creek Road turnoff of Highway 395, if necessary; thereby, avoiding the busier Route 203 offramp.

Mitigation: No mitigation is recommended.

4.3.5.2 Alternative Location Impacts

Impacts would be the same as for the proposed project.

4.3.5.3 Smaller Power Plant Impacts

Impacts would be the same as for the proposed project.

4.3.5.4 No-Action Alternative

Traffic conditions would be unchanged from existing.

4.3.5.5. Abandonment and Reclamation Impacts

Impact: Traffic to and from the project during abandonment and reclamation is not likely to adversely affect traffic on the area.

Mitigation: No mitigation is recommended.

4.3.5.6 Cumulative Impacts

Impact: If more than one geothermal power plant is under construction at one time, Route 203 east of Highway 395 and Hot Springs Road would experience a significant, short-term increase in traffic. No more than two of the power plant units are expected to be under construction at any given time.

Traffic associated with the operation of the existing MP I plant and the proposed power plant units in the Casa Diablo area is not expected to affect service in the area.

Mitigation:

- On busy winter ski weekends, route construction traffic from all geothermal plants onto Hot Springs Road at Sherwin Creek Road to avoid the busy Route 203 / Highway 395 off-ramp.

Effectiveness/Impact: This measure would releive congestion at the busy off-ramp. Traffic and wear on Hot Springs Road would increase, but levels of service would not be affected.

4.3.6 VISUAL RESOURCES

4.3.6.1 Proposed Project Impacts

Impact: Drilling rigs and accessory equipment would be visually strong but temporary elements of the landscape because of their form, size, strong vertical lines, and contrasting colors. Once the wells were completed, the wells would be capped and the drilling equipment would be removed, eliminating any substantial structures from the well sites. The landscape plan includes planting of shrubs and trees to screen well sites.

Mitigation: No mitigation is recommended.

Impacts: The viewpoint from which the most viewers would see the project area is Highway 395 near the meadow containing Mammoth Creek. The generator and condensers, at heights of about 30 feet above grade, would be partially visible through the existing and proposed transplanted trees.

Well pads, wellhead equipment, pipelines, and access roads would become long-term features of the landscape. Grading for well pads and access roads would alter the natural form of the landscape slightly. The smooth, horizontal lines of the roads, and pad surfaces would contrast with the existing slopes and ridges, which are undulating and irregular, without sharp lines or divisions. These project elements would differ in texture, also, from existing natural surface features. The road and well pad surfaces could contrast in color with existing vegetation and surface soils.

Once the drilling rigs and associated equipment were removed from the well pads, the wellhead equipment, fluid transmission lines, and access roads could be visible to northbound traffic from Highway 395 from about one mile southeast of the Casa Diablo area and Route 203 east of Highway 395. Visibility from these viewpoints and the degree of contrast would be moderate, the degree depending upon the exact placement of well pads, alignment of access roads and pipelines, and extent of revegetation and screening. With appropriate mitigation for visual effects, the overall visual impact would be slight to moderate.

The power plant would be the most visible element of the project, visible from Route 203 east of Highway 395 and from northbound Highway 395 from about one mile southeast of

Casa Diablo to one-half mile south of Casa Diablo. At night, work lights and structural lighting of the power plant would be visible. The views of the power plant and accessory structures would create the impression of light industrial activity. Figure 4-1 is a line-of-sight section of the proposed power plant in the existing setting, as seen from the viewpoint on Highway 395 near Mammoth Creek shown on Figure 3-7. The cone of visibility shows topography and vegetation in relation to the power plant. Most of the power plant would be screened from view, but there would be narrow corridors through which almost the entire height of the condensers could be seen.

The proposed project includes the following measures to reduce impacts:

- The power plant site, well pads, pipelines, and new access roads would avoid mature trees whenever possible.
- Disturbed soil areas would be partially or completely revegetated as soon as practical once construction and site development are completed.
- Exteriors of structures, including pipelines, and their supports, would be neutral colors approved by the authorized officer.
- To the extent compatible with engineering considerations, all exterior surfaces would be rough texture, with no reflective metal or glass surfaces oriented toward the south or west.
- Exterior structural lighting would be minimized; where exterior lighting is necessary, diffuse lighting systems would be used. Work lights would be switched or equipped with timers, rather than being designed for continuous use, and workers should be encouraged to minimize the use of night lighting to the extent safely practical.
- Electrical transmission lines would be on pipeline stanchions.
- Native trees would be transplanted and planted on the project site to screen equipment yards and accessory structures, and the lower portions of the major structures on the site.
- Pipelines would be sited so that natural vegetation and terrain provide visual screening to the extent possible.

Screening by trees and shrubs as proposed would be increasingly effective as the vegetation grew taller. Transplanting of trees up to 30+ feet in height would accelerate the screening process. Over a period of about five years the VQO of Retention would be met. See Section 2.1.6 for a discussion of revegetation plans.

Mitigation: No mitigation is recommended.

4.3.6.2 Alternative Location Impacts

Impact: The power plant would be completely screened from view from Highway 395 and Route 203 by topography and vegetation. It would be visible from Antelope Springs Road, the dirt road serving Little Antelope Valley. The pipelines and wellheads would be visible.

Mitigation:

- Require landscaping and other visual screening to lessen visual impacts of the pipeline and well heads.

4.3.6.3 Smaller Power Plant Impacts

Impacts would be the same as for the proposed project.

4.3.6.4 No-Action Alternative Impacts

Impact: Landscaping and revegetation associated with the proposed project would not be done.

Mitigation: No mitigation is recommended.

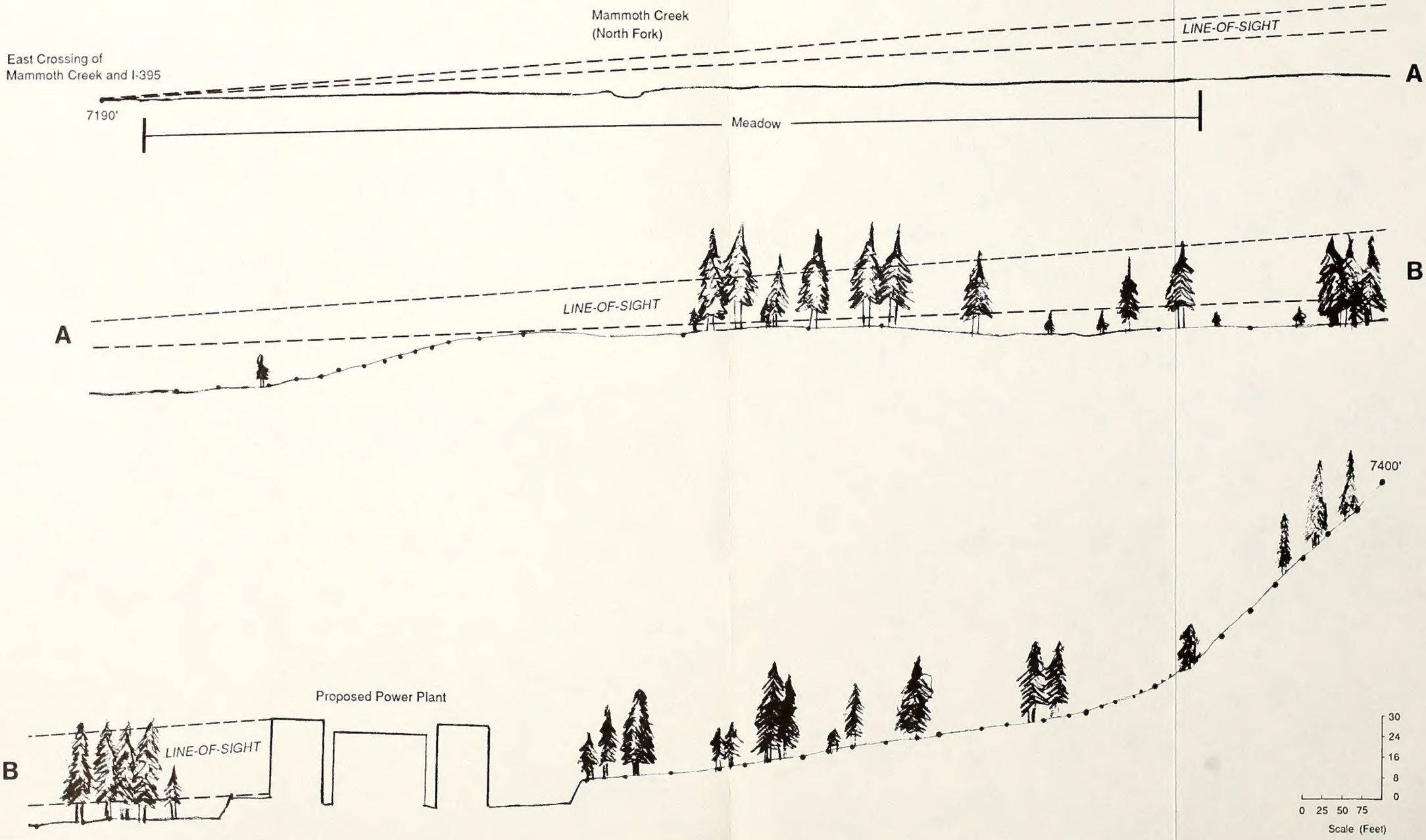
4.3.6.5 Abandonment and Reclamation Impacts

Impact: Recountouring and grading the soil would lead to temporary visual impacts.

Mitigation: No mitigation is recommended.

4.3.6.6 Cumulative Impacts

Impacts: The addition of PLES I and MP II & III to the existing MP I plant would add additional man-made elements to the landscape at the expense of the natural features. The scattered and transplanted trees would provide substantial screening in the background views across the meadow. The MP II & III project, proposed for a site behind the proposed PLES I power plant site would, in effect, be screened from view behind PLES I, which in turn would be screened from the major view corridor along Highway 395 by terrain and by existing and relocated mature trees while new vegetation required by



SOURCE: ESA, Inc., 1988

FIGURE 4-1
Cross-Section Along Line-of-Sight from Highway 395 Near Mammoth Creek to Proposed Power Plant Site

the site reclamation program matured. In views from Highway 395 and Route 203, these power plants and their ancillary facilities would not likely be noticeable to the casual observer. Instead, due to the natural topography, the observer's view would most likely be drawn to the eastern crest of the Sierras, Mammoth Mountain, and the Minarets to the west or to the meadow in the immediate foreground.

In addition, given the existing visual intrusions from the view corridor toward Casa Diablo site (see Visual Resources, Section 3.3.6.4), the cumulative geothermal development at Casa Diablo would not constitute significant visual impacts. The landscape and revegetation measures included in the PLES I project would further reduce the visual impact.

4.3.7 LAND USE AND PLANNING

4.3.7.1 Proposed Project Impacts

Impact: The proposed construction of PLES I would change the partially undeveloped character of the site to one of light industrial activity. The project is compatible with Forest Service plans and would not conflict with existing or planned land uses in the area. No land uses are planned nearby other than the MP II & III geothermal project proposed for the area immediately north of the PLES I site. In addition, no recreational uses are planned for the area.

4.3.7.2 Alternative Location Impacts

The impacts would be the same as for the proposed project.

4.3.7.3 Smaller Power Plant Impacts

The impacts would be the same as for the proposed project.

4.3.7.4 No-Action Alternative Impacts

Land use on the project site would continue in its present state.

4.3.7.5 Abandonment and Reclamation Impacts

Impact: After the changes associated with the PLES I project were removed, the land use would likely return to the present open space / grazing use.

Mitigation: No mitigation is recommended.

4.3.7.6 Cumulative Impacts

Impact: Continuing geothermal resource development on both federal and private lands in the Long Valley would affect land uses directly by transforming several undeveloped areas to light-industrial uses. Geothermal development at Casa Diablo is consistent with Mono County and Inyo National Forest Plans. A total of 60 acres of open space and grazeland would be lost in the development of the proposed Casa Diablo and Mammoth / Chance geothermal projects.

Mitigation: No mitigation is recommended.

4.3.8. EMPLOYMENT, POPULATION AND HOUSING

4.3.8.1 Proposed Project Impacts

Impact: The type and amount of employment generated by the PLES I power plant would differ between the construction phase and operation phase. Based on the work force used during the construction of the existing MP I facility, the construction phase employment is expected to fluctuate with the stage of power plant construction and well drilling, averaging 48 workers over a nine-month period, peaking with 82 workers in the fifth month during the summer when weather conditions are most favorable for construction work. During the operational phase, 16 persons are expected to operate the facility when commercial production begins. The impact upon the local labor force will vary depending on whether the employees are hired locally or brought in from outside the area. A worker who would commute to work from his present address is considered part of the local labor force. Thus, the local area includes the northern part of Inyo County and encompasses the Native American communities in southern Mono County and northern Inyo County.

Three employment scenarios are considered and presented in Table 4-3:

- Minimum local employment (0%) -- entire labor force non-local;
- Mid-range local employment increase (44%) -- only entry level jobs filled by local labor force (Asper, W.E., 1987b); and
- Maximum local employment increase (69%) -- labor force employment pattern similar to patter found at the MP I geothermal plant (Asper, W.E., 1987b).

TABLE 4-3: LOCAL EMPLOYMENT

Level of Local Employment	Average Construction	Peak Construction	Production Operations
Minimum	0	0	0
Mid-range	21	36	7
Maximum	33	56	11

SOURCE: Environmental Science Associates, Inc., 1987.

Since some employment would go to people presently living outside of the area, an increase in the local population would result. The size of the increase would depend on the portion of employment that would go to people living outside of the local area, the labor pattern of households and household size.

For this analysis it is assumed that the average household of each non-local employee would consist of 2.33 persons (California Department of Finance, 1987) and that non-local employees would relocate their households to the local area during their employment. Some non-local construction workers may not relocate their households, thus lessening the actual average number of persons per household. Using the three employment scenarios, the expected population increase is shown in Table 4-4.

Since a portion of employment would go to people presently living outside of the area, a demand for housing would result as these people move into the area. The increased demand would tighten the housing market at the lower end of the price scale and potentially increase the price of housing. Most construction employees would be expected

TABLE 4-4: POPULATION INCREASES

Local Employment	Average Construction	Peak Construction	Production Operations
Minimum	112	191	37
Mid-range	63	107	21
Maximum	35	59	12

SOURCE: Environmental Science Associates, Inc., 1987.

to seek temporary housing while the operating employees could seek permanent housing. Experience during the construction of the MP I geothermal plant indicates there would be no problem housing the construction workforce. In a large measure, this was due to the fact that the greatest population increase coincided with the off-peak season, which increased the ability of the local housing market to meet the increased demand for housing.

The immediate housing market is about 11,000 housing units. About 4,500 are used as permanent housing and 6,500 mainly condominium units, as temporary housing. The vacancy rate for permanent housing is around 2 to 3%. The vacancy rate for temporary housing varies greatly with the seasons and day of the week. The lowest vacancy rates occur during the weekends of the winter skiing season and the highest during the weekdays in the spring and fall.

Under the maximum population increase scenario, the demand for permanent residential housing is expected to increase by less than 0.4%. Given the duration of the development phase, construction of some additional housing for the less expensive end of the housing market can be expected. Although there is currently a relatively high vacancy rate of condominiums in Mammoth Lakes, this condition would not necessarily remain unchanged over the next one or two years, and the condominiums currently being built are generally designed for the most expensive end of the housing market.

If Pacific Energy hires locally, housing needs would be reduced.

Mitigation:

(13) Time construction activity to avoid having the peak construction housing needs coincide with the peak winter tourist housing demand.

Effectiveness/Impact: Minimal additional housing would be required during construction activities. There would be little additional impact caused by implementation of this measure.

4.3.8.2 Alternative Location Impacts

Impacts would be the same as for the proposed project.

4.3.8.3 Smaller Power Plant Impacts

Impacts would be the same as for the proposed project.

4.3.8.4 No-Action Alternative Impacts

There would be no increased housing demand due to PLES I.

4.3.8.5 Abandonment and Reclamation Impacts

Impact: Termination of operations would cause the loss of 11 jobs. If these people could not find other local employment, they would likely leave the area and housing demand would decrease slightly. The temporary work of abandonment and reclamation would be of such short duration it is not likely to create perceptible housing demand.

4.3.8.6 Cumulative Impacts

Impact: The cumulative demand for housing from operation of all four proposed geothermal plants would be about 24 units, less than 0.6% of the permanent housing market and less than 0.3% of the overall housing market. The overall impact on housing would not be significant. Simultaneous construction of two geothermal plants could temporarily tighten the market for nonpermanent housing, an average of 68 workers would seek temporary housing, with 132 workers the largest number seeking temporary housing.

While this demand could prevent rents from falling to their usual off-season lows, its temporary nature would not provide an incentive for developing additional housing. The increased demand would not result in a significant environmental impact.

Similarly, the impacts associated with the employment generated and the maximum population increases, as a result of PLES I is likely to be small in comparison to large-scale proposed projects.

4.3.9 ECONOMICS

4.3.9.1 Proposed Project Impacts

Impact: The local economy would temporarily benefit from the increased retail demand and demand for housing during the peak construction phase, as would employment in the construction sector. The local economy would experience a longer lasting but lower level benefit during the operational phase from retail purchases made by the plant and by plant employees, and from the availability of local entry-level jobs. The local economy would be financed from those property taxes and federal funds. The local economy would benefit from the payroll paid to local construction labor estimated at $500,000 and from approximately $500,000 spent for room and board by temporary construction labor and project supervisory personnel during construction of the project. The direct payroll is expected to be similar to the payroll at the MP I project which totaled $451,000 in 1986. Local trade with Inyo and Mono County merchants from MP I totaled $159,000 in 1986 (Asper, W.E., 1987b). The year-round operation of the plant would help stabilize the highly seasonal nature of employment and retail sales.

Mitigation: No mitigation is recommended.

Impact: The possibility of negative local economic impact is largely associated with the unlikely loss of geothermal water at Hot Creek Gorge and the Hot Creek Hatchery. Such a loss could reduce employment, retail sales, and rentals based on servicing trout fishing and hot spring bathing, increasing the severity of the unbalanced winter/summer tourist economy (Hawley, B., 1987). The hydrology analysis estimates that it is unlikely for temperature or pressure changes in the hydrothermal reservoir to cause changes at the hatchery or the gorge and there would be no economic impact.

The most severe potential impact would occur if year-round operation of Hot Creek Hatchery were not viable due to the total loss of thermal water in the hatchery springs.

To raise an equal number of trout in the colder waters, the cost would be higher due to the larger number of ponds and amount of water required to hold the fish for a longer period until they reached planting size. The loss of the fall spawning trout, which account for 40% of the 2 million eggs and 20% of the fish raised at Hot Creek Hatchery, would eliminate year-round planting of the trout stock and be felt throughout the area west of the Rocky Mountains (Porter, R., 1987). Year-round, the price of eggs ranges from less than $10 per 1,000 to almost $20 per 1,000 eggs, depending on the number of eggs purchased at one time. If the hatchery sold all its Coleman strain eggs for $20 per thousand, the loss of 800,000 eggs would represent lost income of $16,000 annually. In addition, a major part of the facilities for the backcounty aerial planting for the northern Sierra Nevada would have to be relocated other hatcheries (Porter, R., 1987). The project includes provision to, supply thermal water to the hatchery either via pipeline from PLES I or by drilling a well at the hatchery to tap the geothermal reservoir.

Mitigation: See mitigation (7) in Section 4.1.4.3.1.

Effectiveness/Impact: This requirement would provide technical specifications for the potential future monitoring or contingency mitigation measures. The requirement would provide the BLM, and cooperating and consulting agencies, with additional information to ensure that potential monitoring or contingency mitigation measures could be required and implemented in a timely manner, as necessary.

Impact: County revenues are expected to increase by about $250,000 per year based on the 1987 tax levy in Mono County. Increased revenues would come from property taxes, sales taxes, and a portion of the geothermal lease revenues. The property value is expected to increase from approximately $112,000 to over $23,000,000, similar to the property value of the existing MP I plant (McCulloch, L., 1987). The increase in sales to the plant and plant personnel would mainly occur in the Town of Mammoth Lakes and in communities in Inyo County rather than in unincorporated Mono County. Therefore, Mono County can expect only a slight increase in sales tax revenue.

County expenditures are expected to increase. Costs incurred by various county departments would, for most part, be financed out of the general fund and not by applicant fees (e.g., Board of Supervisors, Sheriff, County Counsel). The greatest demand for increased general county services and fiscal expenditures would be associated with the increase in the residential population rather than with the plant itself.

It is estimated by Pacific Energy that PLES I would generate about $95,000 annually in Federal County of Origin Funds. In addition, property taxes are estimated at $300,000 annually based on current valuation methods. Services provided by the county would be financed from property taxes and federal funds.

Mitigation: No mitigation is recommended.

4.3.9.2 Alternative Location Impacts

Impacts would be the same as for the proposed project.

4.3.9.3 Smaller Power Plant Impacts

Impacts would be slightly less than the proposed project because of the smaller size. The labor force would be the same. Economic benefits to the federal government from royalty revenues; and to the local economy from property taxes, county of origin revenues, local employment, local spending and sales taxes would be proportionally less for the smaller power plant than for the proposed project.

4.3.9.4 No-Action Alternative Impacts

The region would forego economic benefits from PLES I.

4.3.9.5 Abandonment and Reclamation Impacts

Impact: The economic benefits to the region would cease after abandonment and reclamation were complete. There would be short-term benefits from employment during reclamation activities.

Mitigation: No mitigation is recommended.

4.3.9.6 Cumulative Impacts

Impact: County revenues from taxes and Federal County of Origin Funds would be about $725,000 per year (based on the 1987 tax levy in Mono County) for the four proposed and one existing geothermal projects. The Draft EIS for Sherwin Bowl indicates that it would be expected to generate up to $720,000 annually in fees to the county during its first five years of operation, depending on the alternative. Other projects with extensive construction components such as Doe Ridge and Snow Creek are likely to be comparable to Sherwin Bowl. As an order of magnitude estimate, the county could expect to receive over three million dollars in revenues from the proposed projects. PLES I would account about 10% of that amount.

Mitigation: No mitigation is recommended.

4.3.10 COMMUNITY SERVICES

4.3.10.1 Proposed Project Impacts

(a) Schools

Impact: The impact on school facilities is tied directly to increased school enrollment. School enrollment in turn will be dependent upon the demographic characteristics of the families of non-local labor force. To estimate enrollment impacts, the Mammoth School District uses a student generation factor of one student per 7.67 persons of permanent population (Martin M., 1987). With an average household size of 2.33 persons and

assuming only one geothermal worker per household, the generation factor is approximately 0.304 students per permanent employee. This is very close to the actual 0.313 students per permanent employee experienced with the MP I geothermal plant (Asper, W.E., 1987).

Using a slightly more liberal factor of 0.33 students per permanent employee, Table 4-5 presents possible enrollment increase for the average construction workforce and permanent employees. It is assumed that non-local workers hired for short term peak period employment would not relocate their families. Because the elementary school is already overcrowded, any increase in the elementary school age population would increase the current overcrowding at the elementary levels (Martin, M., 1987). The increased enrollment associated with construction and permanent employment will not occur simultaneously.

The addition of project-related students could increase overall enrollment to the point where the formation of an additional class would be desired. This would be most likely to occur during the construction phase under the maximum non-local employment scenario. Impacts may also be reduced through increased use of the local labor force as discussed in Section 4.3.8.1 (Employment, Population and Housing).

Mitigation: No mitigation is recommended.

TABLE 4-5: INCREASED SCHOOL ENROLLMENT

Non-Local Employment	Construction	Permanent
Maximum	16	5
Mid-range	9	3
Minimum	5	2

SOURCE: Environmental Science Associates, Inc., 1987.

(b) Police

Impacts: The Mono County Sheriff's Department expects that the attendant increase in the residential population during construction or operation of the geothermal plants would have only a minor impact on the current work load and not require additional law enforcement officers. Vandalism at the site is a potential problem that can be expected both during the construction phase and when the plants are in operation (Padilla, T., 1987). Such criminal activities do not require major investigative efforts by the Sheriff's Department. There may be some increased costs due to housing and transporting of prisoners. There have been no incidents of vandalism reported at the MP I power plant.

Mitigation: No mitigation is recommended.

(c) Medical Facilities

Impact: During the construction phase, construction accidents can be expected. Medical facilities are expected to be operating below capacity if the construction phase does not coincide with the winter ski season. Local hospital staff and facilities regularly handle accident victims with severe injuries and should not be significantly impacted by handling construction accident victims. The health care services of Mono County are not expected to be significantly impacted either during the construction period or by the increase in permanent population under the maximum population increase scenario. Health officials are concerned with the possibility of severe burns and scalding in the event of a geothermal accident. Local facilities are not equipped to handle such cases which would have to evacuated (Jacobsen, T., 1987).

Mitigation:

(14) Revise the county and Inyo National Forest emergency response plans to incorporate emergencies which might arise from geothermal exploration and development activities.

(15) Train on-site personnel in first-aid and Cardio-Pulmonary Resuscitation (CPR).

(16) Develop and maintain communication and evacuation procedures for potential severe burn accidents.

Effectiveness/Impact: Responsible parties would be better prepared to deal with an emergency at the power plant.

(d) Fire Protection

Impact: The construction and operational phases present different concerns. The major concern during the construction phase is the potential for forest or brush fires, especially during the end of the dry summer season. During the operational phase, flammable working fluid would be stored on-site and the possibility of an accident or an equipment failure and the release of the working fluid to the atmosphere is the major concern. In such an event the working fluid could form a cloud at ground level which might be ignited. In both cases the spreading of a fire during the seven- to fifteen-minute response/access time is a serious problem.

Were the fire to spread beyond the immediate area, safety concerns would focus on three areas: (1) traffic on the adjacent U.S. Highway 395; (2) the three 10,000 gallon gasoline storage tanks owned by Chevron, located one-quarter mile east of State Route 203 and one-eight mile north of U.S. Highway 395; and (3) the 100,000 to 150,000 gallons of propane stored in six tanks owned by Cal-Gas, Petro-Lane and Turner, located about one mile from the site (Malby, B., 1987).

A fire prevention and protection plan has been approved by the Long Valley Fire Protection District. The review procedure will allow local fire prevention units to

become familiar with the resources and dangers on the site, and would provide the opportunity for the fire units to request additional details which would help them to deal with possible emergencies at the facility, and to suggest any additional mitigations they may feel are appropriate in light of more detailed knowledge.

Mitigation: No mitigation is recommended.

(e) Street and Road Maintenance

Impact: Heavy loads would be transported over county and Forest Service roads during the nine-month construction period. This may result in the need for additional repair and increased maintenance. Impacted most heavily will be the Hot Springs Road (Mono County Road No. 346A) which provides immediate access to the PLES I site. The volume of traffic generated by the operational work force is not expected to significantly increase the local traffic level of the roadway.

Mitigation:

(17) Transfer the cost of repairing damage to county and Forest Service roads, caused by project activities, to the project proponent. This could be done by posting of performance bonds. Alternatively, a user fee based on weight of vehicle and frequency of use could be imposed.

Effectiveness/Impact: The costs of road repair attributable to the project would not be borne by the county or Forest Service.

Impact: Because air-cooled condensers would be employed instead of wet cooling towers, the potential problems of road icing, induced fog clouds, and the resultant cooling tower blowdown fluids would not present a problem during normal power plant operations. A slight potential for road icing and induced fog clouds exists during well flow testing. Should a vapor cloud be generated during flow testing which could cause icing of roads or reduced visibility on roads, flow testing would be limited by an authorized officer until weather conditions improve. If this procedure is followed, no road icing or induced fog clouds would occur.

Mitigation: No mitigation is recommended.

(f) Wastewater

Impact: Temporary water and sanitary facilities would be provided during construction operations. The expected water requirement for the facility, based on an estimated operational manpower requirement of sixteen people, would be 300 gallons per day. The users would also generate sanitary wastes. There would be no consumptive water use for power plant cooling as air cooling would be used during the operational phase.

Mitigation: No mitigation is recommended.

(g) Solid Waste

Impact: Solid wastes would be generated during drilling of the geothermal walls and construction operations. Waste from both activities are expected to be nonhazardous. Construction wastes composes of inert solids (Group 3 wastes) and organic solids (Group 2 wastes) may be collected and transported to the Class I landfill at Benton Crossing with no adverse effects. The increase in residential wastes associated with the increase in residential population is not expected to significantly affect the lifespan of the Benton Crossing landfill.

Mitigation: No mitigation is recommended.

(h) Utilities

Utilities will be contracted for on a private basis with short extension from the MP I plant. During normal power plant operations, parasitic electric power requirements would be satisfied by electric power generated on-site. During start-up, electric power would be purchased from SCE. No community services would be required.

4.3.10.2 Alternative Site Impacts

Impacts to community services would be the same as for the proposed project.

4.3.10.3 Small Power Plant Impacts

Impacts would be the same as for the proposed project.

4.3.10.4 No Action-Alternative Impacts

No demands due to PLES I would result.

4.3.10.5 Abandonment and Reclamation Impacts

Use of community services would cease after abandonment and reclamation were complete.

4.3.10.6 Cumulative Impacts

(a) Schools

Impact: In the worst-case, a total of 14 permanent new students would be added due to employment at the four proposed geothermal plants. The Draft EIS for Sherwin Bowl indicates it would add no more than seven new students. Environmental documents for Snow Creek and Juniper Ridge, both with condominium units, and Doe Ridge are not available. Even if Snow Creek, Juniper Ridge, and Doe Ridge each result in no more students than Sherwin Bowl, they would account for an additional 21 students. Of the estimated total 42 students, PLES I would account for about 10%.

Mitigation: No mitigation is recommended.

(b) Police

Impact: Impacts cumulatively would be mainly a function of the total population increase. The cumulative effects of all four proposed geothermal power plants is unlikely to place a burden on law enforcement services. The large number of visitors attracted by additional ski facilities would be more likely to require the addition of police officers, so that the contribution of PLES I to the cumulative burden placed on the police department would be minor.

Mitigation: No mitigation is recommended.

(c) Medical Facilities

Impact: Impacts to health care facilities would be a function of the total population increase and probably would not be severe. A total of five geothermal plants, each storing approximately 20,000 gallons of flammable hydrocarbon working fluid and using pressurized geothermal fluids would increase the chance of a severe buring or scalding event.

Mitigation: See mitigations (14), (15), and (16) in Section 4.3.10.1

(d) Fire Protection

Impact: The major fire danger during construction is the potential for brush or forest forest. This would apply equally to all the cumulative projects, roughly in proportion to the area being cleared and its proximity to fuel sources. The PLES I project represents less than 2% of the area being cleared.

Construction is over the assorted projects present very different concerns. About 100,000 gallons of flammable isobutane or other hydrocarbon working fluid would be stored at the five power plants, with 80,000 gallons near Casa Diablo. A fire prevention and protection plan for the project has been approved by the Long Valley Fire Department.

Mitigation: No mitigation is recommended.

(e) Street and Road Maintenance

Impact: Heavy loads would be transported over county and Forest Service roads. This could result in the need for additional repair and road maintenance. The roads used during PLES I construction would also be used while MP III are under construction, so PLES I would account for about one-third of the excess wear on the affected roads, mainly Hot Springs Road.

Mitigation: See mitigation (17) in Section 4.3.10.1.

(f) Wastewater

Impact: The Town of Mammoth Lakes General Plan has identified the need for additional wastewater treatment capacity.

Almost all of that demand would come from additional residents and visitors to the area. The PLES I project would make a minor contribution to the general demand due to the population growth and no direct contribution since wastewater produced at the facility would be disposed of in an on-site septic system.

Mitigation: Suggestions for mitigation of these cumulative impacts are beyond the scope of this EIS/EIR Addendum.

(g) Solid Waste

Impact: Solid waste generation from the cumulative projects would be very large in comparison to the waste generated because of PLES I. The Draft EIS on Sherwin Bowl states that it is expected to generate from 4% to 14% of the amount of solid waste currently produced in the Town of Mammoth Lakes.

Mitigation: No mitigation is recommended.

(h) Utilities

Impact: Cumulative demand for utilities is not likely to cause any impacts to electrical or telephone service.

Mitigation: No mitigation is recommended.

4.3.11 HAZARDOUS MATERIALS

4.3.11.1 Proposed Project Impacts

Impact: During drilling operations, potentially hazardous materials would be stored at the well site. These may include diesel fuel for diesel powered drilling equipment, some

drilling mud additives, and miscellaneous paints or solvents. Spills from containers or from drilling fluids during drilling activities could result in surface contamination.

Mitigation:

(18) Employ the following measures:

- Keep hazardous liquid materials used during drilling operations in sealed containers designed for containment of the hazardous material.
- Keep hazardous dry materials protected from precipitation and unopened within their original manufacturer's packaging until used.
- Store all hazardous materials in an area of the well site surrounded by a berm to contain small spills and designed to drain spilled substances into the lined drilling mud pit.
- Remove unused hazardous materials from the well site immediately after drilling operations have been completed.
- Keep drilling fluids in either a tank(s) or a lined reserve pit during drilling operations.
- Sample and characterize waste drilling mud prior to on-site burial, or off-site disposal, to confirm the water is being disposed of consistent with the requirements of the California Regional Water Quality Control Board, Lahontan Basin Region.

Effectiveness/Impacts: These measures minimize the risk of having hazardous materials which would be used during drilling operations leave the well site and contaminate surface or subsurface water resources.

Impact: During power plant operations, approximately 20,000 gallons of hydrocarbon working fluid would be stored on-site. The working fluid is extremely flammable and a potential fire hazard would result from spills or system upsets. Hydrocarbon detection sensors and alarms are proposed which would warn of detectable concentrations of the hydrocarbon working fluid in excess of approximately one-third its minimum flammability limits. Miscellaneous paints or solvents would also be a source of potential surface contamination from spills.

The proposed project includes a fire and safety program which require:

- keeping potential ignition sources away from the hydrocarbon accumulator and storage tanks areas. Similarly, ignition sources should be kept away from the power plant site drainage courses and proposed catch basin.

- posting "No smoking" and "flammable liquid" signs in all areas except areas specifically designated as smoking areas.

- constructing all hydrocarbon storage and utilization facilities in conformance with applicable industry standards and in compliance with applicable fire and safety codes.

- preparing and reviewing emergency fire and spill continency plans with local fire fighting authorities (see Section 4.3.10.1(d), Fire Protection).

Mitigation:

(19) Sample and characterize soils which are contaminated from spills or leaks of hazardous materials. Remove any waste or contaminated soils characterized as hazardous to a disposal site acceptable to the BLM and approved by the Lahontan Regional Water Quality Control Board.

Effectiveness/Impact: The measures should substantially reduce the risk of fire or spill hazards associated with the storage of hydrocarbon working fluid and other hazardous materials on the power plant site. No further impact would be expected as a result of implementation of their measures.

4.3.11.2 Alternative Location Impacts

Impacts would be the same as for the proposed project.

4.3.11.3 Smaller Power Plant Impacts

Impacts would be the same as for the proposed project.

4.3.11.4 No-Action Alternative Impacts

No additional hazardous materials would be introduced at the project site.

4.3.11.5 Abandonment and Reclamation Impacts

Impact: Hazardous materials uses on the site would be removed as part of the abandonment procedures.

Mitigation:

- Require compliance with all applicable county, state, and federal regulations dealing with removal and disposal of the hazardous materials and wastes.

Effectiveness/Impact: Hazardous materials and wastes would be handled using approved procedures and would be transported and disposed of properly. No further environmental impacts would be expected from implementation of this measure.

4.3.11.6 Cumulative Impacts

Impact: Hydrocarbon working fluid stored at the existing MP I plant and the three currently proposed power plant units in the Casa Diablo area would result in the storage of approximately 80,000 gallons (20,000 gallons at each unit) of highly flammable hydrocarbon working fluid within the immediate vicinity.

Because of their close proximity, a major fire at any one of the power plant units could threaten each of the other power plant units.

Mitigation:

- Emergency spill and fire contingency plans should be prepared for each power plant unit which include emergency communications among the power plant unit operators.

Effectiveness/Impact: Early warning of a fire, or potential fire hazard, would provide power plant operators an opportunity to implement emergency action procedures to protect their respective power plant units. No further impact would be expected from implementation of this measure.

4.3.12 GEOTHERMAL RESOURCE LEASE

4.3.12.1 Proposed Project Impacts

Impact: The proposed project would result in the development and beneficial use of the geothermal resources within the federal geothermal lease as proposed by Pacific Energy.

Mitigation: No mitigation is recommended.

4.3.12.2 Alternative Location Impacts

Impacts would be the same as for the proposed project.

4.3.12.3 Smaller Power Plant Impacts

Impact: Reduction in net output from 10 MWe to 7 MWe would constitute a breach of the existing power purchase agreement between the applicant and SCE and could result in termination of the development proposal. In addition, the reduction in revenue from the electric output of the smaller power plant would reduce the availability of operating revenue to support operating expenses, including the mitigation measures incorporated into the project, and would reduce the economic viability of the project.

Mitigation:

- Approve the proposed project.

Effectiveness/Impact: The geothermal lease would be used beneficially. This document describes environmental impacts of such use.

4.3.12.4 No-Action Alternative Impacts

Impact: The no-action alternative would prohibit the project proponent from developing the federal geothermal lease under the currently proposed Plans of Operation and may limit any future development of the geothermal resource on the lease. The federal geothermal lease requires the lessees to develop the geothermal lease within 10 years of lease acquisition or forfeit the lease. Forfeiture of the lease as a result of no-action alternative decision could significantly constrain future geothermal leasing of federal lands in the Mono-Long Valley area and would forego possible increases in future revenue to the federal, state, or local governments from geothermal lease and royalty payments. In addition, prohibiting the lessees from developing the lease could result in a breach of contract between the lessee and the federal government.

Mitigation:

- Approve the proposed project.

Effectiveness/Impact: The geothermal lease would be used beneficially. This document describes environmental impacts of such use.

4.3.12.5 Abandonment and Reclamation

The lease would terminate upon completion of reclamation.

4.3.12.6 Cumulative Impacts

Impact: The combined geothermal production from the existing MP I power plant, the proposed MP II and III project, and the proposed PLES I project would substantially increase the beneficial use of the available geothermal resources in the Casa Diablo Hot Springs Area.

Mitigation: No mitigation is recommended.

4.4 GROWTH INDUCING IMPACTS

The proposed project would broaden the economic base of Mono County by providing an additional source of ad valorem tax revenue. Growth could also be stimulated from revenues which would come from property taxes, sales taxes and a portion of the federal geothermal lease revenue. In addition, income from local expenditures would be expected, particularly in the Town of Mammoth Lakes (see Section 4.3.9.1).

The project would also provide limited additional opportunities for stable, year-round, employment (see Section 4.3.8.1). Some growth inducing opportunity exists for direct use of the geothermal resource for non-power generating purposes, such as space heating, which could conceivably be developed in conjunction with the proposed project.

However, to date, there have not been any proposals to develop a geothermal cogeneration project in the area. County services could be increased as a result of increased revenue from geothermal development and, from that perspective, could make the area more attractive to potential residents; however, no additional residential development is likely to result from the project.

5.0 AGENCIES, ORGANIZATIONS, AND INDIVIDUALS CONSULTED

The following individuals, organizations, and agency representatives were contacted during this assessment. Where appropriate, specific communications are identified as a reference (see Section 7.0, References).

5.1 PUBLIC AGENCIES

5.1.1 FEDERAL AGENCIES

Bureau of Land Management, Bishop Resource Area Office:

Robert Beehler, Environmental Coordinator
Michael Ferguson, Acting Area Manager
Jim Morrison, Area Manager
Terry Russi, Wildlife Biologist
Mark Ziegenbein, Geologist

Bureau of Land Management, Bakersfield District Office:

Robert Rheiner, District Manager
H. Edward Lynch, Jr., Planning and Environmental Coordinator

Bureau of Land Management, California State Office

Richard Johnson, Deputy State Director - Division of Lands and Renewable Resources
Carl Rountree, Chief, Planning and Environmental Coordination
Sean Hagerty, Geologist, Branch of Fluid Minerals
Douglas Koza, Chief, Branch of Fluid Minerals

Inyo National Forest

Mark Clark, Hydrologist
Tina Hargis, Biologist
Heather Harvey, Planner
J. Lloyd, Developed Sites Foreman
Clinton McCarthy, Forest Wildlife Biologist
Vernon McLean, Geologist
Dennis Martin, Forest Supervisor
M. Morse, Recreation Officer
Linda Reynolds, Forest Archaeologist
E.B. Rickford, Forest Landscape Architect
Dan Totheroh, Forest Engineer
Bob Wood, Winter Sports Specialist

U.S. Fish and Wildlife Service:

Ed Lorentzen
R.H. Porter, Resource Office
Jack Williams

5.1.2 STATE OF CALIFORNIA AND REGIONAL AGENCIES

Air Resources Board

Norma Montey

Department of Fish and Game

Thomas Blankenship, Wildlife Biologist
James L. Eichmann, Manager Hot Creek Hatchery
Robert Holland, Natural Communities Biologist
Dennis McEwan
Philip Pister, Fisheries Biologist
Ronald Thomas, Wildlife Biologist

Department of Transportation

Jack Edell, Environmental Planner
James Racine, Environmental Planner

Division of Oil and Gas

R. Habel, Geologist

Regional Water Quality Control Board, Lahontan Basin Region

Jahill Cass, Water Resources Control Engineer
Curt Shifrer, Water Resources Control Engineer
Keith Turner, Water Resources Control Engineer

Great Basin Unified Air Pollution Control District

Larry Cameron
William Cox, Deputy Air Pollution Control Officer
Ellen Hardebeck, Air Pollution Control Officer

University of California at Davis

Dr. Burgess Kay, Botanist

University of California, Lawrence Berkeley Laboratory:

H. Wolenberg, Geochemist

5.1.3 COUNTY OF MONO (AND SPECIAL LOCAL DISTRICTS)

Scott Burns, Planning Director
Daniel Lyster Director, Office of Energy Management
Lee McColloch, Mono County Assessor's Office
Terry Padilla, Sergeant, Mono County Sheriff's Office

5.1.4 OTHER LOCAL AGENCIES

B. Tillman, Biologist, Los Angeles Department of Water and Power
Thomas Jacobsen, Administrator, Mammoth Lakes School District
Bruce Malby, President and Board of Directors, Long Valley Fire Protection District
Marilyn Martin, Secretary to the Superintendent, Mammoth School District
Brian Hawley, Planning Director, Town of Mammoth Lakes

5.2 PRIVATE ORGANIZATIONS

Ecological Research Services

C. Robert Feldmeth, Ph.D.

Environmental Management Associates, Inc.

Dwight L. Carey, D. Env.
Terry R. Thomas, D. Env.

Mammoth Pacific I Geothermal Plant

Wilbert J. Asper, Manager

Mesquite Group, Inc.

Donald A. Campbell, President
J.S. "Skip" Matlick, Geologist

Pacific Energy

Michael H. Clinton, Director and General Manager - Geothermal
Claude Harvey, Vice President
Donald L. Vinson, Director of Projects
Michael J. Walker, Manager of Geothermal Projects

Razon Associates

G. Milliken, Attorney at Law

Pacific Enterprises

Donald C. Liddell, Special Counsel

Pacific Gas and Electric Company

Ken Divittorio, Department of Engineering Research

Santa Fe Minerals, Inc.

R.W. Potter, Geochemist

5.3 OTHER INDIVIDUALS

Timothy Alpers
Thomas M. Jenkins, Ph.D. - June Lake
Thomas E. Kucera, Doctoral Candidate, U.C. Berkeley - Bishop

5.4 CHRONOLOGY OF PUBLIC INVOLVEMENT

September 3, 1986	Plan of Operation for PLES I project was submitted to Bishop Resource Area (RA).
October 21, 1986	Bishop RA conducted a public site inspection.
November 15, 1986	Comment period on PLES I plan closed.
November 25, 1986	Proposal was issued to contract for preparation of joint EA/EIR.
August 19, 1987	Joint Draft EA/EIR was distributed for public review and comment.
September 15, 1987	Public hearing on Draft EIR was held in Mammoth Lakes.
October 9, 1987	Comment period on PLES I Draft EA/EIR closed.
October 14, 1987	Sierra Club submitted a protest to BLM California State Office (CSO).
February 10, 1988	U.S. Fish and Wildlife Service, after a Section 7 Consultation regarding the Owens tui chub, issued a "No Jeopardy Opinion."
February 11, 1988	Bishop RA and Inyo N.F. approved the PLES I project.
February 26, 1988	CSO dismissed Sierra Club protest.
March 9, 1988	California Department of Fish and Game (Fish and Game) appealed the decision of the Bishop RA.
March 9, 1988	Bishop RA approved the PLES I Plan for Baseline Data Collection.
March 11, 1988	Sierra Club et al. also appealed BLM decision.
March 31, 1988	BLM (CSO) requested an expedited Interior Board of Land Appeals review.

April 8, 1988	Fish and Game appealed the BLM approval of the PLES I Plan for Baseline Data Collection.
May 2, 1988	BLM and Fish and Game met in Sacramento to discuss Fish and Game concerns.
May 12, 1988	Sierra Club et al. and Fish and Game filed their Statement of Reasons with BLM.
May 23, 1988	BLM and Fish and Game met in Bishop to discussed the specific concerns identified by Fish and Game.
May 24, 1988	Final EIR was certified.
May 31, 1988	BLM staff from CSO and solicitor met to evaluate Fish and Game and Sierra Club Statement of Reasons. The decision to require an EIS was made.
June 23, 1988	BLM sends out public notice of the July 8, 1988 public scoping meeting and site visit to identify specific issues and concerns for analysis in the PLES I EIS.
July 8, 1988	BLM conducts public scoping meeting and site visit of the PLES I project area.
August 30, 1988	Memorandum of Understanding between BLM and Great Basin Unified Air Pollution Control District to prepare a joint EIS/SEIR
Sept. 9, 1988	Public notice in Federal Register of the availability of the PLES I Draft EIS No. 880294.
Oct. 21, 1988	The Great Basin Unified Air Pollution Control District conducts a Public Hearing on the Supplemental EIR for the PLES I project.

6.0 REPORT CONTRIBUTORS

This Environmental Impact Statement was undertaken by several organizations and prepared and coordinated through Environmental Science Associates, Inc. (ESA) of San Francisco, California. The organizations and persons principally responsible for the analysis of the respective resource sections of the Joint Environmental Assessment, prepared and coordinated in 1987 for the project by the Environmental Management Associates, Inc. (EMA) of Brea, California, and Draft Environmental Impact Report are listed below.

The original document has been substantially revised by ESA to contain newly gathered information and to respond to concerns raised during review.

Organization	Individual	Section
U.S. Bureau of Land Management, Bishop Area Office (BLM)	Mark Ziegenbein	Purpose and Need for Action
U.S. Forest Service, Inyo National Forest (USFS)	Vernon McLean	Timber and Range
Berkeley Group, Inc. (BGI)	Peter Pyle	Hydrology, Appendix C
Environmental Science Associates, Inc. (ESA)	Sandra Guldman	Introduction, Summary, and Soils
	Kristian Macoskey	Noise
	Gregg Miller	Terrestrial Biology
	Noriko Kawamoto	Aquatic Biology
	Glen Elder	Socioeconomics and Public Service
	Vanessa Hawkins	Recreation, Land Use and Planning
	Bruce Campbell	Visual
Environmental Management Associates, Inc. (EMA)	Terry Thomas	Air Quality, Geology, Hazardous Materials

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8.0 GLOSSARY AND ACRONYMS

AUM - Animal Unit Month - the amount of range land which will support one animal for one month.

Aquifer - a geologic formation, group of formations or part of a formation, capable of yielding a significant amount of ground water to wells or springs (California Code of Regulations, Title 22, Section 66011.1).

BLM - Bureau of Land Management

Bioassay - a test in which aquatic organisms are used to detect or measure the presence or effect of one or more substances, wastes, or environmental factors, alone or in combination, on aquatic organisms.

Binary process cycle - cycle in which a secondary working fluid, such as isobutane (rather than the use of steam directly from the ground), is vaporized and used to power a turbine generator to convert geothermal energy into electricity.

Bishop tuff - consolidated pyroclastic flow and ash fall several thousand feet in thickness within the Long Valley region that resulted from the catastrophic eruption of a massive caldera-forming event approximately 700,000 years ago.

BACT - Best Available Control Technology

Brine - subsurface water with a high content of dissolved salts.

CEQA - California Environmental Quality Act

CFR - Code of Federal Regulations

CPUC - California Public Utilities Commission

Critical habitat - any or all habitat element(s), the loss of which, would appreciably decrease the likelihood of the survival and recovery of an officially listed species. It may represent any portion of the present habitat of an officially listed species and may include additional areas for population expansion. The official determination of critical habitat is the responsibility of the U.S. Fish and Wildlife Service and takes appropriate Federal Register notification and action.

DCM - District Cultural Manager

EIS - Environmental Impact Statement

Endangered species - an animal or plant species which is in danger of extinction throughout all or a significant portion of its range (as defined in The Endangered Species Act Amendments of 1982). This is the definition use by the U.S. Fish and Wildlife Service. The State of California and the California Native Plant Society define the term slightly differently.

Enthalpy - heat content.

Environmental Assessment (EA) - a concise public document for which a Federal Agency is responsible. An EA serves (1) to briefly provide enough evidence and analysis for determining whether to prepare an environmental impact statement (EIS) or a finding of no significant impacts; (2) to aid an agency's compliance with the National Environmental Policy Act when no EIS is needed; and (3) to facilitate preparation of an EIS when one is needed.

Environmental Impact Statement (EIS) - an analytical document that portrays potential impacts on the human environment of a particular course of action and its possible alternatives written in compliance with the Natural Environmental Policy Act. An EIS is developed for use by decision makers to weigh the environmental consequences of a potential decision.

EPA - Environmental Protection Agency

Federal leases - leases administered by the BLM for development of geothermal and other energy resources.

Fumarole - a vent, ususally volcanic, from which gases and vapors are emitted; it is characteristic of a late stage of volcanic activity.

Geothermal - pertaining to the heat of the interior of the Earth.

Geothermal fluids - steam or hot water from the Earth's interior.

Geothermal resources operational orders (GRO Orders) - regulations issued under the Geothermal Steam Act of 1970 enforced by the BLM for geothermal exploration, well drilling, operation, plugging and abandonment, and environmental protection for projects on land under federal jurisdiction.

Groundwater - water below the land surface in a zone of saturation (California Code of Regulations, Title 22, Section 66079).

Hazardous material - a substance or combination of substances which, because of its quantity, concentration, or physical, chemical or infectious characteristics may either:

(1) Cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness: or

(2) Pose a substantial present or potential hazard to human health or environment when improperly treated, stored, transported or disposed of or otherwise managed. Unless expressly provided otherwise, the term "hazardous material" shall be understood also to include extremely hazardous material (CAC, Title 22, Section 66084).

Hydrocarbon - any organic compound, gaseous, liquid, or solid, consisiting solely of carbon and hydrogen.

Hydrogen sulfide (H_2S) - flammable, poisonous gas with charactaristic odor of rotten eggs. Ignition temperature 260°C.

Hydrologic models - a physical or mathematical representation of a hydrologic system. Ordinarily, and accurate model describes how the system acts and how it would repsond to changes.

Hydrologic monitoring - the measurement of a variety of parameters of both ground and surface waters (including temperature, pressure, flow rates, chemistry, etc.) as appropriate.

Injection reservoir - aquifer into which geothermal fluids are injected after some heat has been extracted.

Injection well - a recharge well or input well for storage or disposal of the injected fluid.

Isobutane - (2-Methylpropane), a flammable gas.

KGRA - Known Geothermal Resource Area

kV - Kilavolt - one thousand volts

LVHAC - Long Valley Hydrologic Advisory Committee

MP - Mammoth Pacific

MWe - Megawatt (one million Watts)

Mitigation - the lessening of an adverse effect by avoiding or applying appropriate protection measures (e.g., the recovery of cultural resource data, off-site compensation for diminished habitat, environmental reclamation).

Mitigation measures - methods or procedures undertaken for the purpose of avoiding or reducing potential impacts of an action.

National Environmental Policy Act (NEPA) of 1969 - a law enacted on January 1, 1970, that established a national policy to maintain conditions under which man and nature can exist in productive harmony and fulfill the social, economic and other requirements of present and future generations of Americans. It established the Council on Environmental Quality for coordinating environmental matters at the Federal level and to serve as advisor to the President on such matters. The law made all Federal actions and proposals which could have significant impact on the environment subject to review by Federal, State and local environmental authorities.

National Register of Historic Places (NRHP) - a list of districts, sites, buildings, structures and objects significant in American history, architecture, archaeology and culture maintained by the Secretary of the Interior. Expanded as authorized by Section 2(b) of the Historic Sites Act of 1935 and Section 101 of the National Historic Preservation Act.

NEPA - National Environmental Policy Act

Piezometer - a tube inserted in the ground used to measure the elevation of the groundwater level. It is sealed along its length, open to water flow at the bottom, and open to the atmosphere at the top.

PLES -Pacific Lighting Energy Systems, now known as Pacific Energy

Pounds per square inch gauge - pressure units measured on a gauge which reads zero at atmospheric pressure.

Production reservoir - aquifer which serves as a source of geothermal fluid.

PURPA - Public Utilities Regulatory Policy Act

Range (rangelands) - land dominated by vegetation than can be grazed or browsed and whose husbandry is provided routinely through grazing management instead of renovations or cultural treatment (Range Term Glossary Comittee, 1974).

Refugia - pockets or enclaves of suitable habitat remaining from a formerly much larger habitat.

Rhyolite - a fine-grained rock which is compositionally equivalent to granite.

SCE - Southern California Edison

Scenic quality - the degree of harmony, contrast, and variety within a landscape (used in visual resources management).

Seismicity - the likelihood of an area being subject to earthquakes.

Sensitive receptors - people, plants, or animals which would be sensitive to nearby noises or sources of air pollution.

Siltation - the deposition or accumulation of silt that is suspended throughout a body of standing water or in some considerable portion of it.

Sleepers - horizontal supports which lift a structure off the ground surface.

Subsidence - a sinking of the land surface following the removal of solid mineral matter or fluids (e.g., water or oil) from the subsurface.

Threatened species - an animal or plant species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (as defined in the Endangered Species Act Amendments of 1982). This is the definition use by the U.S. Fish and Wildlife Service. The State of California and the California Native Plant Society define the term slightly differently.

Upwelling/fracture flow - the rising of subsurface water toward the surface through fractures in the rocks.

Visual Resource Management (VRM) - the systematic means to identify visual values, establish objectives which provide the standards for managing those values, and evaluate the visual impacts of proposed projects to ensure that the objectives are met.

Visual resource - the visible physical features on a landscape (e.g. land, water, vegetation, structures, and other features).

VMS - Visual Management System

VQO - Visual Quality Objective

VRM - Visual Resource Management

Water quality - the chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

Watershed - a total area of land above a given point on a waterway that contributes runoff water to the flow at that point.

Well blowout - uncontrolled, release of fluid from a well.

Working fluid - the fluid used to drive the turbine of and electric generator. In a binary power plant, the working fluid is a hydrocarbon with a low boiling point, such as isobutane.

9.0 INDEX

Emergency Spill Containment Plan — 2-20 to 2-23, 2-25, 2-34, 2-40, 4-27, 4-29, 4-76

Geysers, The — 1-9, 1-10, 4-38

Hot Creek Gorge — 1-3, 1-6, 2-7, 2-28, 3-20, 3-22, 3-23, 3-25, 3-26, 3-28, 3-29, 3-32, 3-54, 4-36, 4-39, 4-41 to 4-43, 4-47, 4-51, 4-61 to 4-66, 4-76, 4-87, 4-89, 4-90, 4-94, 4-105,

Hot Creek Hatchery — 1-3, 1-6, 2-7, 2-8, 3-5, 3-19, 3-20, 3-22, 3-23, 3-26 to 3-28, 3-32, 3-45, 3-47, 3-53, 3-61, 3-62, 3-63, 4-30, 4-32, 4-37 to 4-41, 4-44 to 4-46, 4-49, 4-50, 4-52 to 4-57, 4-67, 4-78, 4-80, 4-81, 4-95, 4-96

Owens tui chub — 2-7 to 2-9, 3-46, 3-47, 4-43 to 4-45, 4-47 to 4-49, 4-53, 4-59, 4-60, 4-78

Mammoth Lakes, Town of — 1-12, 2-3, 2-17, 3-55, 3-60, 3-62, 3-65, 3-68, 3-70, 4-23, 4-35, 4-78, 4-105, 4-115, 4-121

Mammoth-Pacific geothermal power plant (MP I) — 2-1, 2-17, 3-1, 3-6, 3-7, 3-10, 3-14, 3-17, 3-18, 3-25, 3-26, 3-29, 3-31, 3-59, 3-62, 3-65, 3-67 to 3-71, 4-9, 4-11, 4-23, 4-24, 4-25, 4-32, 4-34, 4-35, 4-36, 4-38, 4-39, 4-40, 4-42, 4-43, 4-50 to 4-52, 4-61 to 4-65, 4-72, 4-77, 4-89, 4-93, 4-96, 4-100 to 4-105, 4-108, 4-109, 4-112, 4-118, 4-120

Mono County General Plan — 1-11, 3-16

Mono-Long Valley KGRA — 1-5, 2-3

mule deer — 1-9, 2-6, 3-40, 3-42, 3-43

PLES I Joint EA/EIR — 1-2, 1-3, 1-6, 1-10, 2-1, 3-1, 3-27

public scoping meeting — 1-2, 2-1

revegetation program — 2-9, 2-24 to 2-27, 2-35, 2-40

10. PUBLIC REVIEW, COMMENTS AND RESPONSES

10.1 REVIEW PROCESS

This chapter summarizes the public and agency comments received on the Draft Environmental Impact Statement/Supplemental Environmental Impact Report (EIS/SEIR) prepared for the PLES I Geothermal Project and responses to those comments.

The Draft EIS/SEIR was available for review in September and October 1988. The document was distributed to interested parties on Great Basin Unified Air Pollution Control District (GBUAPCD) and Bureau of Land Management (BLM) lists. The State Clearinghouse also distributed copies to state agencies. The GBUAPCD held a public hearing on the Draft EIS/SEIR on October 21, 1988 in the Town of Mammoth Lakes.

Comments on the Draft EIS/SEIR were received in two forms: letters and oral statements made at the public hearing. Comment letters sent to the GBUAPCD were also sent to the BLM and are included in this Final EIS/SEIR. Statements made at the public hearing were transcribed by the GBUAPCD. Each submission was assigned a number code to assist in organization of this document. Each separate topic within a submission was assigned a separate number. Thus, if an agency or citizen made three different comments, they would be designated, for example, 2-1, 2-2, and 2-3. Table 10-1 is the Comment Index which lists the commenter, the comment code, the page where the response can be found, and the general topic covered by the comment.

Comments and responses are grouped in this document by subject matter and are arranged by topics corresponding to the Table of Contents in the Draft EIS/SEIR. All substantive comments are referred to by number only. The reader may review the entire comment in context by referring to Section 10.2.2 of this document. This was done to delete repetitive and nonsubstantive material and to avoid misinterpretation by paraphrasing or condensing comments. Each group of comments is then followed by a response.

As the subject matter of one topic may overlap that of other topics, the reader must occasionally refer to more than one group of Comments and Responses to review all information on a given subject. Where this occurs, cross references are provided.

These comments and responses, together with the Draft EIS/SEIR constitute the Final EIS/SEIR for the PLES I Geothermal Project.

10.2 COMMENTS

10.2.1 LIST OF PERSONS COMMENTING

1. Michael L. Sorey, U.S. Geological Survey. November 8, 1988.

2. Eugene V. Toffoli, Legal Advisor, California Department of Fish and Game, The Resources Agency. Letter to James Morrison, Area Manager, Bureau of Land Management. October 21, 1988.

3. Hamilton Hess, Geothermal Coordinator, Sierra Club. Letter to James Morrison, Area Manager, Bureau of Land Management. October 22, 1988.

4. Emilie Strauss, Private Citizen. Letter to Bureau of Land Management. October 23, 1988.

5. Dan Lyster, Director, Energy Management, County of Mono. Letter to James Morrison, Area Manager, Bureau of Land Management. October 5, 1988.

6. Frank Stewart, Toiyabe Chapter, Sierra Club. Letter to James Morrison, Area Manager, Bureau of Land Management. October 24, 1988.

7. Ellen Hardebeck, GBUAPCD. Draft EIS/SEIR public hearing comments. November 7, 1988.

8. Michael J. Walker, Manager of Operations - Geothermal, Pacific Energy. Letter to James Morrison, Area Manager, Bureau of Land Management. November 4, 1988.

9. David E. Clapp, Environmental Health Scientist, Department of Health and Human Services. Letter to James Morrison, Area Manager, Bureau of Land Management. October 21, 1988.

10. Gary Flynn, Mayor, Town of Mammoth Lakes Planning Department. Letter to James Morrison, Area Manager, Bureau of Land Management. October 6, 1988.

11. Andrew J. Zeilman, Chief, Transportation Planning Branch, California Department of Transportation. Letter to Bishop Resource Area. October 14, 1988.

12. David L. Harlow, Acting Field Supervisor, Endangered Species, U.S. Fish and Wildlife Service. Letter to James Morrison, Area Manager, Bureau of Land Management. October 21, 1988.

13. Christopher Farrar, Water Resources Division, U.S. Geological Survey. Letter to James Morrison, Area Manager, Bureau of Land Management. November 8, 1988.

14. Dan Lyster, Director, Energy Management, Mono County. Letter to James Morrison, Area Manager, Bureau of Land Management. November 23, 1988.

These letters include those received by the Great Basin Unified Air Pollution Control District.

10.2.2 WRITTEN COMMENTS AND HEARING SUMMARY

Table 10-1 is the Comment Index, which lists the commentor, the comment code, the page where the response can be found, and the general topic covered.

TABLE 10-1: COMMENT INDEX

Name/Agency	Comment Code	Page No.	Topic
Michael L. Sorey, U.S. Geological Survey	1-1	10-182	Water Quality and Hydrology
	1-2	10-182	Water Quality and Hydrology
	1-3	10-183	Water Quality and Hydrology
	1-4	10-183	Water Quality and Hydrology
	1-5	10-184	Water Quality and Hydrology
	1-6	10-184	Water Quality and Hydrology
	1-7	10-184	Water Quality and Hydrology
	1-8	10-185	Water Quality and Hydrology
Eugene V. Toffoli, California Department of Fish and Game	2-1	10-212	Aquatic Resources
	2-2	10-185	Water Quality and Hydrology
	2-3	10-170	General
	2-4	10-211	Aquatic Resources
	2-5	10-185	Water Quality and Hydrology
	2-6	10-202	Vegetation
	2-7	10-186	Water Quality and Hydrology
	2-8	10-186	Water Quality and Hydrology
	2-9	10-206	Terrestrial Wildlife
	2-10	10-175	Alternatives
	2-11	10-206	Terrestrial Wildlife
	2-12a	10-170	General
	2-12b	10-173	General
	2-13a	10-171	General
	2-13b	10-171	General
	2-14	10-187	Water Quality and Hydrology
	2-15	10-187	Water Quality and Hydrology
	2-16	10-187	Water Quality and Hydrology
	2-17	10-187	Water Quality and Hydrology
	2-18	10-187	Water Quality and Hydrology
	2-19	10-188	Water Quality and Hydrology
	2-20	10-187	Water Quality and Hydrology
	2-21	10-188	Water Quality and Hydrology
	2-22	10-189	Water Quality and Hydrology
	2-23	10-189	Water Quality and Hydrology
	2-24a	10-189	Water Quality and Hydrology
	2-24b	10-182	Water Quality and Hydrology
	2-24c	10-187	Water Quality and Hydrology

TABLE 10-1: COMMENT INDEX (Continued)

Name/Agency	Comment Code	Page No.	Topic
Eugene V. Toffoli, California Fish and Game (Continued)	2-25	10-202	Vegetation
	2-26	10-211	Aquatic Resources
	2-27	10-218	Economics
	2-28	10-171	General
	2-29	10-171	General
	2-30	10-172	General
	2-31	10-172	General
	2-32	10-172	General
	2-33	10-172	General
	2-34	10-171	General
	2-35	10-209	Terrestrial Wildlife
	2-36a	10-202	Vegetation
	2-36b	10-210	Terrestrial Wildlife
	2-36c	10-173	General
	2-37	10-189	Water Quality and Hydrology
	2-38	10-208	Terrestrial Wildlife
	2-39	10-208	Terrestrial Wildlife
	2-40	10-212	Aquatic Resources
	2-41	10-180	Geology, Soils, and Erosion
	2-42	10-190	Water Quality and Hydrology
	2-43	10-181	Geology, Soils, and Erosion
	2-44	10-174	General
	2-45	10-179	Noise
	2-46	10-189	Water Quality and Hydrology
	2-47	10-212	Aquatic Resources
	2-48	10-191	Water Quality and Hydrology
	2-49	10-201	Vegetation
	2-50	10-191	Water Quality and Hydrology
	2-51	10-189	Water Quality and Hydrology
	2-52	10-187	Water Quality and Hydrology
	2-53	10-191	Water Quality and Hydrology
	2-54	10-191	Water Quality and Hydrology
	2-55	10-190	Water Quality and Hydrology
	2-56	10-192	Water Quality and Hydrology
	2-57	10-202	Vegetation
	2-58	10-172	General
	2-59	10-202	Vegetation
	2-60	10-202	Vegetation
	2-61	10-206	Terrestrial Wildlife
	2-62	10-206	Terrestrial Wildlife
	2-63a	10-179	Noise
	2-63b	10-170	General
	2-64	10-209	Terrestrial Wildlife
	2-65	10-209	Terrestrial Wildlife

TABLE 10-1: COMMENT INDEX (Continued)

Name/Agency	Comment Code	Page No.	Topic
Eugene V. Toffoli, California Fish and Game (Continued)	2-66	10-206	Terrestrial Wildlife
	2-67	10-210	Terrestrial Wildlife
	2-68	10-201	Vegetation
	2-69	10-206	Terrestrial Wildlife
	2-70	10-206	Terrestrial Wildlife
	2-71	10-206	Terrestrial Wildlife
	2-72	10-209	Terrestrial Wildlife
	2-73	10-212	Aquatic Resources
	2-74	10-213	Recreational Resources
	2-75	10-213	Recreational Resources
	2-76a	10-171	General
	2-76b	10-172	General
	2-77	10-210	Terrestrial Wildlife
	2-78	10-202	Vegetation
	2-79	10-202	Vegetation
	2-80	10-202	Vegetation
	2-81	10-173	General
	2-82	10-208	Terrestrial Wildlife
	2-83	10-206	Terrestrial Wildlife
	2-84a	10-206	Terrestrial Wildlife
	2-84b	10-209	Terrestrial Wildlife
	2-85	10-206	Terrestrial Wildlife
	2-86a	10-206	Terrestrial Wildlife
	2-86b	10-208	Terrestrial Wildlife
	2-87	10-173	General
	2-88a	10-174	General
	2-88b	10-170	General
	2-89	10-186	Water Quality and Hydrology
	2-90	10-170	General
Hamilton Hess, Sierra Club	3-1	10-175	Alternatives
	3-2	10-180	Geology, Soils, and Erosion
	3-3	10-218	Land Use and Planning
	3-4	10-192	Water Quality and Hydrology
	3-5	10-172	General
	3-6	10-214	Visual Resources
	3-7	10-215	Visual Resources
	3-8	10-212	Aquatic Resources
	3-9	10-192	Water Quality and Hydrology
	3-10	10-193	Water Quality and Hydrology
	3-11	10-193	Water Quality and Hydrology
	3-12	10-201	Vegetation
	3-13	10-175	Alternatives
	3-14	10-201	Vegetation
	3-15	10-179	Noise
	3-16	10-208	Terrestrial Wildlife

TABLE 10-1: COMMENT INDEX (Continued)

Name/Agency	Comment Code	Page No.	Topic
Hamilton Hess, Sierra Club (Continued)	3-17	10-178	Air Quality
	3-18	10-178	Air Quality
	3-19	10-178	Air Quality
	3-20	10-180	Geology, Soils, and Erosion
	3-21	10-181	Geology, Soils, and Erosion
	3-22	10-181	Geology, Soils, and Erosion
	3-23	10-181	Geology, Soils, and Erosion
	3-24	10-181	Geology, Soils, and Erosion
	3-25	10-193	Water Quality and Hydrology
	3-26	10-201	Vegetation
	3-27	10-194	Water Quality and Hydrology
	3-28	10-179	Noise
	3-29	10-180	Noise
	3-30	10-180	Noise
	3-31	10-180	Noise
	3-32	10-194	Water Quality and Hydrology
	3-33	10-191	Water Quality and Hydrology
	3-34	10-194	Water Quality and Hydrology
	3-35a	10-172	General
	3-35b	10-202	Vegetation
	3-36	10-202	Vegetation
	3-37	10-201	Vegetation
	3-38	10-206	Terrestrial Wildlife
	3-39	10-209	Terrestrial Wildlife
	3-40	10-195	Water Quality and Hydrology
	3-41	10-212	Aquatic Resources
	3-42	10-212	Aquatic Resources
	3-43	10-212	Recreational Resources
	3-44	10-179	Noise
	3-45	10-212	Aquatic Resources
	3-46	10-212	Aquatic Resources
	3-47	10-214	Recreational Resources
	3-48	10-217	Visual Resources
	3-49	10-217	Visual Resources
	3-50	10-215	Visual Resources
	3-51	10-214	Visual Resources
	3-52	10-217	Land Use and Planning
	3-53	10-219	Economics
	3-54	10-173	General
Emilie Strauss, Private Citizen	4-1	10-202	Vegetation
	4-2	10-211	Aquatic Resources

TABLE 10-1: COMMENT INDEX (Continued)

Name/Agency	Comment Code	Page No.	Topic
Dan Lyster, Mono County	5-1	10-216	Visual Resources
	5-2	10-216	Visual Resources
	5-3	10-195	Water Quality and Hydrology
	5-4	10-195	Water Quality and Hydrology
Frank Stewart, Sierra Club	6-1a	10-175	General
	6-1b	10-170	Alternatives
	6-2	10-176	Alternatives
	6-3	10-176	Alternatives
	6-4	10-175	Alternatives
	6-5	10-171	General
	6-6	10-177	Alternatives
	6-7	10-176	Alternatives
	6-8	10-209	Terrestrial Wildlife
	6-9	10-195	Water Quality and Hydrology
	6-10	10-195	Water Quality and Hydrology
	6-11	10-176	Alternatives
	6-12	10-176	Alternatives
	6-13	10-176	Alternatives
	6-14	10-205	Vegetation
	6-15	10-201	Vegetation
	6-16	10-176	Alternatives
	6-17	10-173	General
	6-18	10-178	Air Quality
	6-19	10-172	General
	6-20	10-172	General
	6-21	10-172	General
	6-22	10-180	Geology, Soils, and Erosion
	6-23	10-180	Geology, Soils, and Erosion
	6-24	10-196	Water Quality and Hydrology
	6-25a	10-191	Water Quality and Hydrology
	6-25b	10-191	Water Quality and Hydrology
	6-26	10-212	Aquatic Resources
	6-27	10-212	Aquatic Resources
	6-28	10-193	Water Quality and Hydrology
	6-29	10-212	Aquatic Resources
	6-30	10-191	Water Quality and Hydrology
	6-31	10-196	Water Quality and Hydrology
	6-32	10-196	Water Quality and Hydrology
	6-33	10-196	Water Quality and Hydrology
	6-34a	10-196	Water Quality and Hydrology
	6-34b	10-182	Water Quality and Hydrology
	6-35	10-196	Water Quality and Hydrology
	6-36	10-196	Water Quality and Hydrology
	6-37	10-171	General
	6-38	10-206	Terrestrial Wildlife

TABLE 10-1: COMMENT INDEX (Continued)

Name/Agency	Comment Code	Page No.	Topic
Frank Stewart, Sierra Club (Continued)	6-39a	10-172	General
	6-39b	10-173	General
	6-39c	10-177	Alternatives
	6-40	10-206	Terrestrial Wildlife
	6-41	10-209	Terrestrial Wildlife
	6-42	10-210	Terrestrial Wildlife
	6-43	10-210	Terrestrial Wildlife
	6-44	10-210	Terrestrial Wildlife
	6-45	10-212	Aquatic Resources
	6-46	10-197	Water Quality and Hydrology
	6-47	10-213	Cultural Resources
	6-48	10-213	Recreationl Resources
	6-49	10-212	Aquatic Resources
	6-50	10-213	Recreational Resources
	6-51	10-213	Recreational Resources
	6-52	10-215	Visual Resources
	6-53	10-215	Visual Resources
	6-54	10-173	General
	6-55	10-173	General
	6-56	10-173	General
	6-57	10-173	General
	6-58	10-173	General
	6-59	10-173	General
	6-60	10-217	Land Use and Planning
	6-61	10-217	Land Use and Planning
	6-62	10-197	Water Quality and Hydrology
	6-63	10-196	Water Quality and Hydrology
	6-64	10-218	Economics
	6-65	10-219	Community Services
	6-66	10-219	Geothermal Resource Lease
Ellen Hardebeck, GBUAPCD	7-1	10-171	General
	7-2	10-192	Water Quality and Hydrology
	7-3	10-171	General
	7-4	10-213	Recreational Resources
	7-5	10-213	Recreational Resources
	7-6	10-211	Aquatic Resource
	7-7	10-213	Recreational Resources
	7-8	10-213	Recreational Resources
	7-9	10-215	Visual Resources
	7-10	10-181	Geology, Soils, and Erosion
	7-11	10-186	Water Quality and Hydrology
	7-12	10-214	Recreational Resources
	7-13a	10-176	Alternatives
	7-13b	10-216	Visual Resources
	7-14	10-177	Terrestrial Wildlife

TABLE 10-1: COMMENT INDEX (Continued)

Name/Agency	Comment Code	Page No.	Topic
Ellen Hardebeck, GBUAPCD (Continued)	7-15	10-176	Alternatives
	7-16	10-186	Hydrology and Water Quality
	7-17	10-180	Geology, Soils, and Erosion
	7-18	10-212	Aquatic Resources
	7-19	10-177	Alternatives
Michael J. Walker, Pacific Energy	8-1	10-171	General
	8-2	10-205	Vegetation
	8-3	10-181	Geology, Soils, and Erosion
	8-4	10-197	Water Quality and Hydrology
	8-5	10-186	Water Quality and Hydrology
	8-6	10-208	Terrestrial Wildlife
	8-7	10-186	Aquatic Resources
	8-8	10-213	Cultural Resources
	8-9	10-214	Timber Resources
	8-10	10-179	Air Quality
	8-11	10-180	Geology, Soils, and Erosion
	8-12	10-180	Geology, Soils, and Erosion
	8-13	10-197	Water Quality and Hydrology
	8-14	10-212	Aquatic Resources
	8-15a	10-187	Water Quality and Hydrology
	8-15b	10-197	Water Quality and Hydrology
	8-16	10-190	Water Quality and Hydrology
	8-17	10-197	Water Quality and Hydrology
	8-18	10-194	Water Quality and Hydrology
	8-19	10-197	Water Quality and Hydrology
	8-20	10-196	Water Quality and Hydrology
	8-21	10-197	Water Quality and Hydrology
	8-22	10-197	Water Quality and Hydrology
	8-23	10-197	Water Quality and Hydrology
	8-24	10-209	Terrestrial Wildlife
	8-25	10-209	Terrestrial Wildlife
	8-26	10-205	Vegetation
	8-27	10-219	Economics
	8-28	10-171	General
	8-29	10-174	General
	8-30	10-171	General
	8-31	10-174	General
	8-32	10-174	General
	8-33	10-174	General
David E. Clapp, U.S. Dept. of Health and Human Services	9-1	10-178	Air Quality
	9-2	10-178	Air Quality

TABLE 10-1: COMMENT INDEX (Continued)

Name/Agency	Comment Code	Page No.	Topic
Gary Flynn, Town of Mammoth Lakes	10-1	10-210	Terrestrial Wildlife
	10-2	10-190	Water Quality and Hydrology
	10-3	10-210	Terrestrial Wildlife
	10-4	10-198	Water Quality and Hydrology
	10-5	10-217	Visual Resources
	10-6	10-201	Vegetation
	10-7	10-189	Water Quality and Hydrology
	10-8	10-210	Terrestrial Wildlife
	10-9	10-215	Visual Resources
	10-10	10-219	Community Services
	10-11	10-210	Terrestrial Wildlife
	10-12	10-171	General
Andrew Zeilman, Cal. Dept. of Transp.	11-1	10-214	Transportation
David L. Harlow, U.S. Fish and Wildlife Service	12-1	10-187	Water Quality and Hydrology
	12-2	10-187	Water Quality and Hydrology
	12-3	10-187	Water Quality and Hydrology
	12-4	10-187	Water Quality and Hydrology
	12-5	10-187	Water Quality and Hydrology
	12-6	10-188	Water Quality and Hydrology
	12-7	10-187	Water Quality and Hydrology
	12-8	10-187	Water Quality and Hydrology
	12-9	10-189	Water Quality and Hydrology
	12-10	10-189	Water Quality and Hydrology
	12-11	10-189	Water Quality and Hydrology
	12-12	10-182	Water Quality and Hydrology
Christopher Farrar, U.S.Geologic Survey	13-1	10-174	General
	13-2	10-198	Water Quality and Hydrology
	13-3	10-200	Water Quality and Hydrology
	13-4	10-198	Water Quality and Hydrology
	13-5	10-198	Water Quality and Hydrology
	13-6	10-199	Water Quality and Hydrology
	13-7	10-182	Water Quality and Hydrology
	13-8	10-199	Water Quality and Hydrology
	13-9	10-189	Water Quality and Hydrology
	13-10	10-196	Water Quality and Hydrology
	13-11a	10-199	Water Quality and Hydrology
	13-11b	10-198	Water Quality and Hydrology
	13-11c	10-196	Water Quality and Hydrology
	13-12	10-199	Water Quality and Hydrology
Dan Lyster, Mono County	14-1	10-197	Water Quality and Hydrology

10.2.2 WRITTEN COMMENTS AND HEARING SUMMARY

Written comments to the Draft EIS/SEIR and the minutes of the public hearing are included in this section.

United States Department of the Interior

GEOLOGICAL SURVEY

November 8,1988

Comments on Draft EIS for PLES 1 Geothermal Project at Casa Diablo

Michael L. Sorey
U.S. Geological Survey
Menlo Park, California

The following remarks and the enclosed comments dated June 27, 1988 are submitted in the hope that they will improve the subject EIS and clarify some areas of controversy surrounding future geothermal developments in the Long Valley caldera.

Conceptual Models

Several inferences are made in the EIS to the effect that thermal waters from various springs and wells show differences in chemistry and stable isotope contents that are best explained by the Upwelling/Fracture Flow Model, rather than the Lateral Flow Model (e.g p. 3-29, 3-32 to 3-34). The thrust of this argument is that the Upwelling/Fracture Flow Model does not require manipulation of the chemical data to account for the observed differences. It is also argued in the EIS (p. 3-34) that at Casa Diablo the chemical and isotopic data from wells and springs are in close agreement. I would agree that there are chemical and isotopic differences between thermal waters in different parts of the caldera, but I believe they can be satisfactorily explained by relatively simple combinations of mixing with nonthermal water groundwater and near-surface boiling. The isotope data show just as much variation between wells and thermal springs at Casa Diablo as between these springs and the springs in Hot Creek gorge. So one cannot avoid accounting for the effects of mixing and boiling by calling on the Upwelling/Fracture Flow Model. Furthermore, for this model to account for the observed differences in spring chemistry and isotopy in different parts of the caldera, it is necessary to postulate separate deep reservoirs with distinct chemical and isotopic contents - a rather complex situation in itself.

1-1

Reservoir Pressure Support from Injection

All simulations of reservoir pressure response to geothermal development discussed in Chapter 4 and Appendix C are based on 100 percent pressure support by injection. The results of these simulations indicate that minimal pressure changes will occur in the vicinity of the Fish Hatchery and Hot Creek gorge. It is further argued (p. 36, App. C) that a high rate of natural recharge to the system would have a similar influence on reducing impacts of development. Although I agree that the small amount of reservoir

1-2

pressure change occurring at Casa Diablo to data requires that one or both effects must be occurring, it should be noted that we do not as yet know which process is dominant. Consequently, it is difficult to predict the level of reservoir pressure change resulting from additional development. If 100 percent injection support occurs, significant pressure changes within and at distance from the developed area are unlikely. Of course in this case breakthrough of cooler injection water may cause premature temperature declines in production wells. If, on the other hand, reservoir pressure at Casa Diablo is being supported mainly by induced recharge, there is no guarantee that additional production will be matched by additional recharge. That process cannot as yet be adequately simulated because the characteristics of the recharge region are not known. I think that for the EIS to be viewed as objective, this limitation of the pressure modeling results needs to be emphasized.

1-2

A somewhat related matter is that of the impact of an induced reservoir pressure change beneath the Fish Hatchery or Hot Creek gorge on the flow of thermal springs in these areas. Discussions in the EIS (p. 4-38, 4-40) are not very enlightening on this issue. A better way is to relate such a pressure change (say 1 psi) to the pre-existing reservoir pressure at each local, which is typically about 10 percent above hydrostatic pressure beneath areas of hot spring discharge. Then if one assumes a thermal reservoir at a depth of 500 ft beneath the Hatchery (based on the temperature profile in well (MW-1)), the pre-existing reservoir pressure would be 200 psi + 20 psi, or 220 psi. A change of 1 psi would then reduce the excess pressure driving hot water upward (and hence the flow of the thermal springs) by 1/20 or 5 percent. In the EIS, a 1 psi change in reservoir pressure is converted to a 2.5 ft change in water level in a well. This does not convey much useful information as how the springs would be affected.

1-3

Reservoir Temperature Changes

In both the draft EIS and in public statements by representatives of the developers at Casa Diablo the claim is made that production at the existing MP 1 plant has resulted in no decline in reservoir temperature at Casa Diablo (e.g. p. 4-36 of EIS and Review-Herald October 27, 1988). This is simply not true if one considers the injection zone as part of the reservoir. Because water at temperatures near 80°C is being injected into a zone initially at temperatures near 150°C, cooling of this zone must extend from the injection wells to distances that are increasing with time and could conceivably cause cold water breakthrough in production wells if there are permeable connections between production and injection zones. Such connections are required for there to be 100 percent pressure support by injection. So geothermal development at Casa Diablo has caused reservoir temperature declines and additional developments will

1-4

1-4 cause more declines in temperature in the injection zone and ultimately in the production zone.

Calculations of reservoir temperature declines due to geothermal development made by Papadopulos and Associates (1988) using a heat budget approach are criticized on p. 4-37 of the EIS for being based on unreasonably low values of reservoir size and heat in place. The "more realistic " value for heat in place attributed to Sorey (1988) is actually an estimate of heat that could be recovered from portions of the geothermal system situated to the west of Casa Diablo if production induced hot water recharge to move into the reservoir at
1-5 Casa Diablo. Thus, considering induced hot water recharge or a larger reservoir of heat available to the wells at Casa Diablo amounts to the same thing. Of course, if reinjection provides 100 percent pressure support, as assumed in the BGI reservoir performance simulations, there will be little or no induced recharge of hot water so that the reservoir temperature declines calculated by Papadopulos and Associates for the Casa Diablo area might be valid. As indicated in the previous paragraph, however, such declines would occur mainly in the injection zone.

Other scenarios for reservoir temperature changes accompanying
1-6 development are discussed in my comments of June 27, 1988. I suggest including them in the EIS since they are cited in that document.

Results of Bulk-Model calculations discussed on p. 4-40 to 4-42 are referred to as worst case conditions because a relatively low value of reservoir porosity was used. I would think that worst case conditions should also involve a reservoir thickness less than 500 ft. Using for
1-7 example a thickness of 100 ft would yield estimates of the distance to the edge of the cold-temperature front approximately five times greater than those listed on p. 4-40. It would also be instructive to include an analysis of what happens to the cold-temperature front after 30 years, for cases of cases with and without continued injection.

Finally, in the discussion of results of the BGI heat budget calculations (p. 4-42), the sentence that begins with "The analysis here, taken from Appendix C, instead of ..." has had some essential wording left out. The missing information is that a reservoir heat storage of 10×10^{17} cal and a porosity of 15 percent were used. While
1-8 it can be argued that the larger reservoir volume used by BGI is appropriate for the reservoir block at Casa Diablo, there is little justification for BGI's use of similar sized blocks to evaluate temperature changes east of Casa Diablo. Because of the way reservoir temperature changes are simulated to the east of Casa Diablo in this approach, such large reservoir blocks force the calculated temperature declines at the Hatchery and Hot Creek gorge to be very small.

United States Department of the Interior

GEOLOGICAL SURVEY

June 27, 1988

Comments on "Evaluation of Geothermal Development within Long Valley" - a Report by S.S. Papadopulos & Associates, Inc.

Michael L. Sorey
U.S. Geological Survey
Menlo Park, California

At the request of the Bureau of Land Management's Sacramento office, I have reviewed the report cited above. My comments on this report and on the related issues of 1) the effectiveness of hydrologic monitoring in detecting changes in the hydrothermal system due to geothermal production and 2) the effectiveness of proposed mitigation measures to prevent or reduce impacts of geothermal development to acceptable levels are given below.

Papadopulos Report

This report presents an analysis of the changes in stored heat and temperature in part of the Long Valley hydrothermal system between Casa Diablo and the Hot Creek Fish Hatchery resulting from geothermal production at 47 MW over a 20-year period. An energy balance approach is used in which changes in stored heat are computed from the difference between convective heat input and output and net heat outflow from geothermal power production. A continuous reservoir 300 m thick is assumed to extend between Casa Diablo and the Fish Hatchery and this region is subdivided into four blocks, each 300 m thick, for calculating changes in reservoir temperature with time. Hot water inflow to Block #1 at Casa Diablo is set equal to 32.5 L/s at 200^{o}; inflow to each of the other blocks equals 32.5 L/s at 200^{o}C plus the cumulative inflow to the adjacent blocks to the west at temperatures that decline with time with the average temperature of each block. The total hot water inflow to and outflow from the four-block model is thus 130 L/s. The principal conclusions of the report are 1) that heat extraction for geothermal power production at Casa Diablo and Chance Springs (Meadow) will

cause large reservoir temperature changes in the production areas (up to 150°C after 20 years) and significant reservoir temperature changes beneath the Fish Hatchery (7° to 67°C after 75 years) and 2) that hydrologic monitoring could not detect adverse impacts before irreversible changes have been created.

To begin with, there is nothing inherently wrong with the energy balance approach utilized in this report. Indeed, the general conclusion that geothermal power production at rates proposed for Long Valley would cause large reservoir temperature declines, in the absence of significant induced inflow of hot water from adjacent regions, is in fact valid. Reference to this matter was made in the EIR for the Mammoth/Chance project (p. 3-32) in terms of a personal communication from me to the effect that only 3 percent of the required heat for the project is stored in the production reservoir beneath the project area. Furthermore, significant changes in reservoir pressure may not occur during development if pressure support is provided by reinjection of produced fluids, but there remains an energy deficit that will cause significant temperature declines unless alleviated by induced inflow of hot water.

The effect of such induced inflow would be to supply heat to the project area from other parts of the geothermal system. Calculations presented on p.2 of the Papadopulos report suggest that even if this were to occur, the potential yield of the geothermal system (1.5×10^8 cal/s from natural convective heat discharge and recoverable heat in storage) is approximately equal to the net heat production rate for the total proposed electric power production of 47 MW, and thus significant impacts to the natural geothermal system are inevitable. Unfortunately, no justification is given for the assumed 1×10^{17} cal of "stored heat that could be mined [by development]". Although published estimates of about 50×10^{17} cal for recoverable heat in the Long Valley geothermal system (Muffler and Williams, 1976; Muffler, 1979) are probably unreasonably large, a more realistic estimate based on recent drilling data from the west moat of the caldera would be about 10 times larger than the value noted in the Papadopulos report.

The controversy that has developed over the impacts of geothermal development on thermal springs at the Fish Hatchery and Hot Creek gorge is due in large part to uncertainty regarding both the degree to which thermal areas between Casa Diablo and Hot Creek gorge are hydrologically connected and the response to development of the geothermal system in the vicinity of each project area. At this stage, no one knows for sure if there is in effect a continuous thermal reservoir between Casa Diablo and Hot Creek gorge or if proposed geothermal developments will induce inflow of hot water from reservoirs at greater depths and/or capture the natural throughflow of thermal water at relatively shallow depths. Answers to these questions are needed before we can predict the magnitude of changes in temperature, pressure, and spring flow rates that could be induced by development. For example, if hot water inflow should occur at Casa Diablo at rates equal to or greater than the natural throughflow rate of 250 L/s (see Sorey and Lewis, 1976; or Papadopulos report, p. 9), temperature drops calculated for Block 1 by the method used in the Papadopulos report would be considerably less than the 150°C value calculated for an inflow of 32.5 L/s.

Potential impacts of geothermal development on thermal springs are best discussed under three possible scenarios that could accompany development. Under scenario (1), there is a natural throughflow of hot water at about 250 L/s moving through the volcanic section between Casa Diablo and Hot Creek gorge. Development at Casa Diablo (and Mammoth/Chance) would lower reservoir pressures sufficiently to capture all the natural throughflow (i.e. redirect it from the thermal springs to the production wells). The resultant reservoir temperature decline in each project area would be considerably less than calculated by Papadopulos & Associates, as discussed above. However, capture of the natural throughflow could result in pressure declines in the vicinity of the thermal springs with resultant declines in spring flow, unless injection wells were located and completed so as to maintain pre-development reservoir pressures near the margins of the project area. Migration of relatively cool injected water toward the thermal springs could eventually cause declines in reservoir temperature beneath the springs. An analysis of this process, included in Appendix I of the joint

EIR/EA for the MP II and MP III projects, suggested that "breakthrough of cool injected fluid is not likely to be a potential threat to existing springs", but the analysis was admittedly very approximate and limited by lack of knowledge of reservoir flow paths. Application of the method used by Papadolpulos & Associates, in which reservoir cooling near the Hatchery results from a decline in the temperature of fluid flow toward the Hatchery from the west, would suggest that cooling of the Hatchery springs could eventually occur under this scenario.

Under scenario (2), the natural throughflow is unaffected by development (or does not exist within a simple lateral flow system at shallow depths), but significant quantities of fluid and heat are induced to flow upward from a deep reservoir beneath the volcanic section into the project area. This is more or less the scenario postulated by the developer at Casa Diablo. This results in the minimum possible impacts at Casa Diablo and at the thermal springs. Using, for example, a value for the recoverable thermal energy in the geothermal system within the southwestern part of the caldera that is ten times the heat stored in Block 1 of the Papadopulos model, the calculated temperature drop in Block 1 assuming this heat could be captured would be only 15^{o}C after 20 years (all other conditions being the same as in the Papadopulos model).

Scenario (3) would be the case assumed in the Papadopulos report - no capture of natural throughflow or heat stored in surrounding regions. Development under these conditions results in the maximum possible declines in reservoir temperature, both in the project areas and beneath the thermal springs. One qualifying point that should be noted is that because the thermal fluid component in the Hatchery springs is small (only a few percent), a given change in the temperature of the thermal reservoir supplying the Hatchery would not cause an identical change in the temperature of the springs. For example, a 30^{o}C change in reservoir temperature should cause about a 1^{o}C change in spring temperature.

Clearly the nature of the response of the geothermal system to development will play an important role in determining the impacts of development on thermal springs. Because this response cannot be adequately

predicted at the present time, a prudent course of action has been recommended. This is to set up a monitoring program to accompany development that is capable of detecting changes in the system before they become large and irreversible, and to require mitigation measures in the event that changes are detected by the monitoring program. Measurements of pressure and temperature in production and injection wells are considered part of the monitoring program. Changes in these parameters should provide the first indications that changes in the geothermal system are being induced. Indeed, it is inconceivable that with such monitoring, temperature declines in project areas as large as those postulated in the Papadopulos report could go unnoticed or that significant alteration or cessation in the development scheme would not have been put into effect long before temperature changes became that large. In addition, the most immediate effect of a net energy withdrawl in the project areas should be breakthrough of cooler injected water in production wells. This would occur long before temperature declines occur in the vicinity of the thermal springs. Should an EIS be prepared for the proposed development at Casa Diablo, the issue of reservoir temperature changes within the project area deserves more discussion and analysis than that given so far in Appendix I of the Joint EIR/EA for the MP II and MP III projects.

Effectiveness of the Hydrologic Monitoring Program

A hydrologic monitoring program has been developed by the U.S. Geological Survey, in collaboration with the Long Valley Hydrologic Advisory Committee, to detect impacts of both geothermal and nonthermal groundwater development projects on springs at the Fish Hatchery and Hot Creek gorge. The program became operational on June 1, 1988, with funding provided initially by Mono County. With regard to the existing and proposed geothermal projects at Casa Diablo, this monitoring program covers all aspects of the Plan for Baseline Monitoring approved by the BLM that apply to hydrologic issues, except for compilations of existing data, monitoring

of CD supply springs at the Fish Hatchery, and collection of sediment data in streams.

The key elements of the monitoring program are frequent measurements of the discharge characteristics of thermal springs (flow rate, temperature, chemistry) and pressure and temperature in observation wells. The most difficult part of setting up the program is the completion of suitable observation wells. The criteria for such wells is that they be in hydrologic communication with production and injection reservoirs and located between the development field and the thermal springs. Logically, observation wells should first be drilled near the downstream margins of the development field. If no changes attributable to development were found in these wells, additional observation wells would not be needed. If changes were detected and mitigation measures such a relocating production or injection wells failed to reverse these changes, additional observation wells would have to be drilled closer to the thermal springs.

The existing monitoring program includes one observation well (65-32) drilled to a depth of 250 ft at the southeastern edge of the Casa Diablo project area. Although temperature, pressure, and fluid chemical data indicate that this well is in hydrologic communication with the production zone at Casa Diablo (400 to 700 ft), an additional well is needed at this location that taps the deeper injection interval (1000 to 2000 ft), along with well tests to determine the degree of hydrologic connection between both wells and the production and injection wells. Similar requirements for observation well completion and reservoir testing for the Mammoth/Chance project were described in my comments to Dan Lyster, Mono County Energy Management Department, dated January 4, 1988 (copy enclosed).

Successful operation of the monitoring program requires cooperative efforts by the developers, the regulatory agencies, and the agency responsible for conducting and reported on the monitoring. Proper interpretation of monitoring data to discern natural variations from those induced by development may require considerable hydrologic expertise and involve debate between experts. Little experience is available from other areas that could be used to access the likelihood of success of this effort.

We do have the record of over three years of operation of the MP I plant at Casa Diablo during which time no impacts to thermal springs at the Fish Hatchery or Hot Creek gorge have been detected by measurements made by the U.S. Geological Survey. The system response to that development appears to involve no significant decline in reservoir pressure, either due to pressure maintainance by reinjection or the presence of a constant pressure boundary such as a fault that connects the production zone with a deeper, more permeable reservoir. Temperature declines in the vicinity of the injection wells are large (30^{o} - 70^{o}C), but the position of the cold temperature front at distance from these wells is unknown. Considering all the above factors and observations, my opinion at this point is that the existing monitoring program, if augmented by a deeper observation well that taps the injection zone at Casa Diablo and if expanded with additional observation wells drilled closer to the thermal springs as needed, will be adequate to detect changes in the hydrothermal system due to geothermal developments at Casa Diablo.

Effectiveness of Proposed Mitigation Measures

Mitigation measures proposed to prevent or reduce impacts of geothermal developments on thermal springs to acceptable levels are contained in the February 11, 1988, Record of Decision for the PLES I Plan of Operation. The thrust of these measures is to require that additional monitor wells be drilled closer to the thermal springs if changes in the hydrothermal system are detected at closer-in monitor wells and that temporary and permanent modifications in the production/injection scheme be carried out to reverse any changes detected at monitor well locations. If such measures are not effective in stopping the migration of induced pressure or temperature changes through the hydrothermal system toward the thermal springs, the final action would be to discontinue power production.

Overall, I think these mitigation measures in combination with the monitoring program provide an adequate level of protection for the thermal springs. Some qualifying remarks are in order, however. First, I recommend that monitor wells at each location be constructed so as to communicate with

both production and injection zones, as discussed in the previous section. Ideally, step-out monitor wells (as noted in measures 1 and 4) should be in place before changes are detected in close-in monitor wells in order to determine the natural level of variation in pressure and temperature away from the project area and to assure that induced changes have not already spread away from the project area. Data gathered from drilling step-out wells would also allow a better conceptual model of the hydrothermal system to be delineated for predictive purposes. To lessen the economic burden this would place on the developer, I suggest waiting until power is on line to require that at least one step out well be drilled in the vicinity of Colton Spring. Finally, there appears to be little latitude for changes in production/injection well locations or depths given present lease boundaries and concerns over premature breakthrough of cooler water. This places even more importance on the early detection of induced changes in monitor wells and serious consideration of curtailment of power production if such changes are observed.

Conclusions

The analysis presented in the Papadolpulos report describes one possible way in which the hydrothermal systems could respond to geothermal development. Other types of response are possible. A properly conceived and implemented hydrologic monitoring program should be capable of determining what the actual response is. More importantly, such monitoring provides for early detection of changes in reservoir conditions within project areas and between these areas and the thermal springs. The Papadolpulos report suggests that temperature changes in thermal springs could take place long after the development period is over and hence monitoring cannot provide protection against such impacts. This situation should not occur, however, if reservoir temperature changes in and around project areas are detected by the monitoring program in the early stages of development, and suitable mitigation measures are then implemented.

United States Department of the Interior

GEOLOGICAL SURVEY

January 4, 1988

Comments on impacts of the Mammoth/Chance geothermal development on thermal springs at the Fish Hatchery and Hot Creek gorge

Michael L. Sorey
U.S. Geological Survey
Menlo Park, California

The following comments are intended to more clearly state my opinions and recommendations regarding potential impacts of the proposed Mammoth/Chance development by Bonneville Pacific Corporation on thermal springs at the Fish Hatchery and Hot Creek gorge. My testimony at the appeals hearing on December 14, 1987, may have cast an overly negative light on the geologic and hydrologic uncertainties which exist and the consequent level of risk that this project poses to the thermal springs. I still maintain that the source and extent of hot water to be produced by this project are poorly known at present and that flow tests conducted by Bonneville Pacific in 1985 did not provide sufficient information in this regard. However, I believe it is possible to proceed with this development in a manner that would avoid significant hydrologic impacts, provided several conditions are met.

The first condition is that one or more observation wells be completed in such a way that they are in hydrologic connection with the production reservoir and located between the production area and the thermal springs. Successful completion of such wells may need to await new subsurface information from exploratory drilling and may require several attempts to drill in different locations and to defferent depths. The responsibility for this work should rest with Bonneville Pacific, whereas the responsibility for verifying that the wells are adequate for the intended purpose should rest with Mono County and the Long Valley Hydrologic Advisory Committee. Wells to monitor the impacts of reinjection may also be required if it is determined that changes induced by reinjection could reach the springs before changes induced by production.

With suitable observation wells in place, flow tests on production wells should be carried out to adequately stress the production reservoir, so as to make possible determinations of the source and extent of the available resource and the potential for lateral migration of induced pressure changes toward the thermal springs. Such tests would require that fluid be reinjected as far as possible from production wells. By comparing the results of such tests with additional tests involving reinjection closer in, it should be possible to delineate the degree of pressure support to be provided by reinjection and the likelihood of premature breakthrough of cooler water in production wells.

Recent consultations with Bonneville Pacific representatives has indicated to me their willingness to meet these conditions, as outlined in their draft proposal for short-term resource testing and monitoring. It is my opinion that if observation well drilling and well testing were properly carried out, a satifactory long-term monitoring program were in place, and mitigation measures set forth in the Conditional Use Permit were enforced as needed, the hydrologic impacts of the Mammoth/Chance development would be relatively minor. The same would be true for the Mammoth Pacific developments at Casa Diablo. Furthermore, information and experience that could be gained if these relatively small-scale projects were allowed to proceed would undoubtably assist in determining potential impacts of larger-scale geothermal developments that may occur on adjacent federal lands.

State of California — The Resources Agency

Memorandum

To : 1. Projects Coordinator
Resources Agency

2. Ms. Ellen Hardebeck, APCO
Great Basin Unified Air
Pollution Control District
157 Short Street, Suite 6
Bishop, CA 93514

Date : October 26, 1988

From : Department of Fish and Game

Subject : PLES I Geothermal Development Project: Draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR) Supplement, Mono County - SCH 86122913

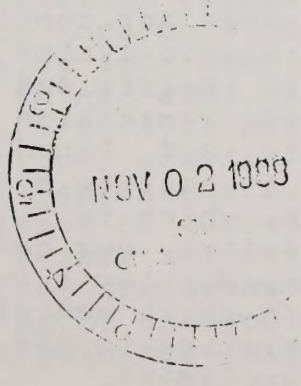
The Department of Fish and Game commented on the joint DEIS/EIR for the subject project located in the Casa Diablo area of the southwestern part of Long Valley, Mono County. The DEIS supersedes the Final EIR for this project, that was released in May 1988. We, therefore, regard this supplement as an EIR if it is to be considered a joint California Environmental Quality Act/National Environmental Policy Act (CEQA/NEPA) document.

Attached is a copy of our letter dated October 21, 1988 to Mr. Jim Morrison, Area Manager, Bureau of Land Management. This attached letter constitutes the Department's comments to the Great Basin Unified Air Pollution Control District. As the letter concludes, the Department believes that the DEIS/EIR is substantially flawed and fails in several aspects to comply with crucially important sections of CEQA and NEPA.

Thank you for the opportunity to review and comment on this project. If you have any questions, please contact Fred Worthley, Regional Manager of Region 5, at 330 Golden Shore, Suite 50, Long Beach, CA 90802 or by telephone at (213) 590-5113.

Pete Bontadelli
Director

Attachment



DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
SACRAMENTO, CALIFORNIA 95814
(916) 445-5095

October 21, 1988

Mr. Jim Morrison, Area Manager
Bureau of Land Management
Bishop Resources Area
787 North Main Street, Suite P
Bishop, CA 93514-2498

Dear Mr. Morrison:

PLES I Geothermal Development Project: Draft EIS/EIR Supplement,
Inyo County - SCH 86122913

The Department of Fish and Game has reviewed the joint Draft EIS/EIR for the subject project located in the Casa Diablo area of the southwestern part of Long Valley in Mono County. The Draft EIS supercedes the Final EIR for this project that was released in May, 1988. We therefore regard this Supplement as an EIR if it is to be considered a joint CEQA/NEPA document.

2-1 The proposed project poses serious threats to the Mammoth and Hot Creek ecosystems, the flora and fauna that are obligate residents of thermal springs, and the habitat types dependent upon these thermal springs in and around the project area. The potential for irreversible and unmitigable adverse impacts to these ecosystems and wildlife in the area greatly increases as several geothermal power producing projects are constructed. We find the joint document inadequate in meeting CEQA and NEPA requirements and therefore recommend adoption of the "No Project" alternative for the following reasons:

1. Impacts to the Geothermal Resources Supporting Hot Creek Hatchery and Hot Creek Gorge.

2-2 Among the major concerns to the Department is the loss or degradation of geothermal resources in the Long Valley Known Geothermal Resource Area (KGRA) which supports recreational needs for an expanding number of people. An unmitigable impact to this highly valued resource is unacceptable. The Department does not concur with the analysis of the Long Valley hydrologic system (BGI Report), given the potential for irreversible impacts and the importance of the system to local and statewide recreation. Our consulting groundwater hydrologists, S.S. Papadopulos & Associates, Inc., is conducting a separate hydrologic resource analysis of the Long Valley KGRA, which is likely to be completed by December 10, 1988. Therefore, our comments on the hydrologic system are based on Papadopulos's initial findings and are presented in Attachment A which henceforth represents the Department position relating to the applicable hydrologic sections of the DEIS/EIR Supplement.

With regard to the Long Valley KGRA, Papadopulos concludes (1) that geothermal development will create thermal "pits" within the geothermal system, (2) that "pits" will ultimately migrate to areas of natural thermal discharge (Hot Creek Hatchery and Hot Creek Gorge springs), and (3) that the temperatures or heat flux of the natural discharges will be reduced. Calculations on the amount of heat removed through energy production indicate that a significant and unmitigable impact to the Hot Creek spring system is to be expected with further development. The issues identified by Papadopulos are based on an entirely new concept which accurately predicts that impacts to the Long Valley KGRA would be significant. Furthermore, since ". . . the exact nature of the hydrologic system and how the subsurface system and the surface features are interrelated cannot be defined at this time" (see document Appendix C, Page 4-43), it is required by NEPA that a reasoned assessment of the environmental impacts of a course of action be based on a "worst-case" analysis.

2-2

2-3

Our Department has recently contracted with Papadopulos to develop a physically based model for predicting the impacts of geothermal development on the natural discharge areas. A three-dimensional model will be used for correctly predicting the formation and migration of the "thermal pits". The model will be capable of predicting the impacts of development based on hydrologic and geologic data already available for the actual geothermal system.

2. Potential for and Realized Loss of Thermal Springs and Related Fauna, Flora, and Habitats in the Proximity of the Existing Development and Future Developments.

Further development of the Long Valley geothermal resource will result in incremental loss of thermal springs and an associated impact on all dependent flora, fauna, and habitat types (i.e. botanically sensitive thermal marsh). The document does not identify existing and potential impacts to plants, animals, or habitat types obligate to the thermal springs located throughout the Long Valley KGRA even though the Department has on several occasions requested that the results of appropriate studies be incorporated into the document. We hereby incorporate by reference Department comments on Revised Draft Joint EA and EIR, the Department's Statement of Reasons for the April 8, 1988 Notice of Appeal of the Plan of Baseline Data Collection, and BLM notes from May 23, 1988 meeting with Department representatives. The lead agency has failed to provide results of surveys at all thermal springs such as outlined in Dr. Herbst's invertebrate survey proposal (see Attachment B). Other organisms may reside in these springs such as unique forms of anaerobic bacteria which as a primitive life form present valuable insight into how

2-4

life on earth evolved in an anaerobic atmosphere (Brock, T.D., "Life at High Temperatures", Science 158 (1967): 1012-19). The Department is mandated by the State Legislature to maintain sufficient populations of all species of aquatic organisms to ensure their continued existence. In the absence of such surveys, the Department cannot evaluate project impacts or identify those sites which may currently harbor unique, rare, threatened, or endangered species and thereby require protection.

2-4

Dr. Sorey of the U.S. Geological Survey states ". . . it should be noted that there are as yet no examples to be cited of long-term development of geothermal fields where nearby hot springs have been protected from the impacts of development, and many examples where development has had negative impacts on such springs" (Sorey 1987 "Comments on Effects of Geothermal Development on Thermal Spring at the Hot Creek Fish Hatchery and Hot Creek Gorge Near Mammoth Lakes, California, .5 p.). Furthermore, he states ". . . detailed records collected by the U.S. Geological Survey during the 1985-87 period show that the flow of hot springs on the west side of Hot Springs Road at Casa Diablo has been affected by geothermal fluid production. In fact, the flow of these springs decreased to zero in March 1987 and the springs have remained dry or nearly so since that time". Dr. Sorey has documented that the existing level of geothermal development at Casa Diablo has resulted in the loss of thermal springs. A loss of the species dependent on those springs is assumed. The proposed buildup of nearly seven times the current development will almost certainly destroy all nearby thermal springs and ecosystems.

2-5

3. Potential for Impacts to Thermal Marsh Habitat (Wetland).

The existence of a thermal marsh (wetland habitat) located in the Casa Diablo Hot Springs area is identified as a botanically sensitive area (Page 3-39 and Appendix D). This habitat type is supported by some of the same local thermal springs which are likely to be further impacted by continued geothermal development.

Additionally, the pumping of groundwater for use in power plant maintenance and fire safety purposes can lower the water level of the shallow fresh water aquifer at Casa Diablo, thereby impacting shallow rooted vegetation (Page 4-35). The document refers to the potential loss of thermal marsh only in the context of direct ground disturbances (Page 4-65) but ignores the potential loss of source water, that of thermal springs probably draining to ground water. The impact of groundwater pumping and subsequent lowering of the water table on thermal marsh habitat is not addressed in the document.

2-6

2-6 The U.S. Forest Service, the federal agency responsible for surface resources at the proposed PLES I project site, is mandated under Executive Orders 11990 and 11988 to protect riparian and wetland resources. These Orders are consistent with Department policy for protection of wetlands. Mitigation is required in the event any development or conversion would result in a net reduction of wetland acreage or wetland habitat values. This document is inadequate in identifying impacts to riparian/wetland habitat and the mitigation measures necessary to offset such impacts.

4. Temperature Data at Hot Creek Hatchery Springs.

2-7 Throughout the document reference is made to variable temperatures and flows of the springs supplying Hot Creek Hatchery (Pages 3-27, 2-47, -48, 4-37, 12-14 and Figures 1-10 through 1-14, Appendix C). Although flows at these springs do seem to vary, temperatures remain relatively constant (C.D. Farrar, U.S. Geological Survey, personal communication) (see Attachment D). The temperature data cited in the document was supplied by the Hot Creek Hatchery manager at the request of the Forest Service hydrologist, project proponents, and consultants. The data set used in the document provides only a rough approximation of average temperatures at the four major Hatchery spring sources and thus cannot be used to represent spring temperature variability or stability. The current monitoring effort will allow for accurate assessment of the variability at these springs, which is important when determining the impacts of geothermal development on the thermal reservoir.

2-8 The temperature data on Hot Creek Hatchery in the section on "Affected Environment" (Pages 3-47 and 3-48) are given in Farenheit, but in the section on "Environmental Consequences" the temperature figures are in Celsius degrees. The document states that "A reduction of 2°F in the present temperature range would delay spawning until Spring due to the increased time period necessary for egg maturation. This would, for all practical purposes eliminate the Coleman and Hot Creek strains and severely impact the hatchery's statewide trout planting program." The impacts to the hatchery resulting from a 0.2°C temperature decline after 20 years should be given in Farenheit and projected over the life of the project after 20, 40, 60, 80, and 100 years.

5. Direct, Indirect, and Cumulative Impacts to Terrestrial Wildlife and Mule Deer.

2-9 The document provides a vague and misleading discussion of some direct project impacts to wildlife resources, especially migratory deer. Secondary and cumulative impacts are also

inadequately discussed. The document concludes that impacts are insignificant while areas of disagreement exist in the discussion on impacts to wildlife in the Biotic Assessment (Appendix D) and the Deer Study Report (Appendix E). Such disagreement shows substantial uncertainty of project impacts. The section on "Environmental Consequences, Terrestrial Wildlife" does contain some vague reference to impacts which "may" occur or which are "possible", but no meaningful mitigation measures are proposed for impacts to terrestrial wildlife. Similarly, the document does not undertake a reasoned analysis of cumulative impacts to migratory deer or other wildlife.

2-9

In our appeal IBLA No. 88-303 of the prior Environmental Assessment for this project the Department stated that no major development should be approved in the Mammoth Basin vicinity prior to completion of a comprehensive cumulative impacts study to examine all reasonably foreseeable projects and their additive effects on all natural resources. Such an interagency effort is now being proposed by the Mono County Planning Department.

The document's deer study (Appendix E) mentions that "the initially proposed site" for the plant would be preferable to the currently proposed configuration "From the standpoint of deer migration and summer use . . .". This refers to the location site as proposed in the Finding of No Significant Impact (FONSI) dated February 11, 1988. However, this site location alternative is not mentioned or analyzed in the draft document. In Methow Valley Citizens Council vs. Regional Forester the Court found in regard to discussions of project alternatives that "an EIS is rendered inadequate by existence of a viable but unexamined alternative".

2-10

From the above, we conclude that the project as proposed would result in non-compliance with the existing Buttermilk, Sherwin Grade, and Casa Diablo Deer Herd Plans, which were jointly approved and adopted by the U.S. Bureau of Land Management, U.S. Forest Service, and the Department. These plans present the creation of specific management guidelines, including preservation of migratory deer habitats. This project site is such a habitat, thereby effectively becoming a federal cooperatively designated deer herd management area (see Department EA Appeal, Statement of Reasons, Page 2).

2-11

6. Inadequacy of Proposed Mitigations.

The Draft EIS/EIR Supplement is inadequate because it lacks specific mitigation measures to offset the adverse impacts identified in the document, which in most cases are considered significant. A vast majority of the impacts lack a thorough

2-12a

discussion of the reasons why "No mitigation is recommended". Such statements are contrary to CEQA/NEPA requirements (Sundstrom vs. County of Mendocino and Methow Valley Citizens Council vs. Regional Forester). Several examples are given in our specific comments on this project in Attachment C to this memorandum. Additionally, under cumulative impacts for biological, recreational, and hydrological resources, the mitigation provided is some sort of advisory opinions to other permitting agencies. For example, on Page 4-65 the document states "Responsible agencies should require revegetation plans for all projects.". Such mitigation measures are non-specific and meaningless because they neither identify the responsible agency nor do they disclose for public and agency review the specific measures required for this project. Again, on Page 4-69 the document states that "Cumulative impacts to local deer herds are potentially significant." However, under mitigation the document states "New projects should contribute to off-site mitigation measures proportioned to their relative impacts on deer." The document fails to discuss the off-site mitigation measures and why this project should not be required to provide mitigation.

2-12b

a For the above reasons, the Department concludes that the DEIS/EIR is substantially flawed and fails in several aspects to comply with crucially important sections in CEQA and NEPA. We hereby incorporate by reference all documents and correspondence filed by the Department in its appeal of the FONSI and the Plan of Baseline Data Collection and all comments filed during scoping meetings for this project.

2-13

b

Thank you for the opportunity to review and comment on this project. If you have any questions, please contact Fred Worthley, Regional Manager of Region 5, at 330 Golden Shore, Suite 50, Long Beach, CA 90802 or by telephone at (213) 590-5113.

Eugene V. Toffoli
Legal Advisor

Attachments

Attachment A

General Comments

Impacts to the Hydrologic Resources of the Natural Geothermal System Supporting Hot Creek Hatchery and Hot Creek Gorge

Important environmental issues regarding the proposed project are (1) the individual impacts of the PLES I project on spring discharges and (2) the cumulative impacts of the PLES I project together with other projects on those discharges. The principal springs at issue include the springs in the Hot Creek Gorge area and the springs in the Fish Hatchery area. The PLES I project and other existing and proposed projects will have a significant adverse impact on the thermal component of spring discharges, but an adequate evaluation has not been made of the impacts.

2-14

The projects will "mine" heat from the natural geothermal system in order to produce electrical power. The cumulative rate of heat production, or rate of mining, for the existing and proposed projects will be about 1.5 x 10 (8) calories per second. Over the planned 30-year life of the projects, a total of 1.4 x 10 (17) calories of heat will be removed. This will result in the cooling of part of the geothermal system. In the affected areas the temperature within the geothermal system will be reduced by as much as 100 degrees Centigrade. The affected volume of the geothermal system will be 2.6 x 10 (9) cubic meters. If the assumption is made that the system is 150 meters or 500 feet in thickness, the affected surface area will be 170 square kilometers or 7 square miles. Therefore, the mining of heat will create thermal "pits" within the geothermal system that have a depth of 500 feet and a cumulative surface area of 7 square miles. These "pits" are analogous to the excavations of open-pit mines. However, in the case of geothermal development, heat is excavated instead of mineral ore.

2-15

The cumulative volume of the thermal pits is independent of whether the source of the mined heat is stored or replenished heat. As a more general statement, it is also independent of the conceptual model that applies to the geothermal system. This can be understood from the following analogy: Imagine a barrel that has been filled with water to overflowing from a garden hose. Now consider the first of two situations. The tap is still on and water is overflowing from the barrel. Then, a bucket is dipped into the barrel, and a bucket-full of water is removed. The overflow from the barrel stops because the water level in the barrel is now below its top. The overflow remains stopped until the barrel refills from the flow in the hose. Now, consider the second situation. Instead of dipping the bucket into the barrel, the hose is removed from the barrel in order to fill the bucket. While the hose is removed from the barrel, the overflow from the barrel stops. In each case the flow stopped, and the length of time that the overflow is stopped is identical. Accordingly, no

difference exists between taking water from storage (the first case) or taking water from the supply (the second case). Exactly the same result applies to the removal of heat from the geothermal system, where in the analogy the overflow is the natural heat discharge from the geothermal system. The source of the heat has no influence on the ultimate impact.

Initially, individual pits will form around each of the existing and proposed projects. However, as geothermal projects are operated over a 30-year period or longer, the pits will increase continuously in size. In some instances, the pits of adjacent projects may eventually merge to form a single larger pit. Ultimately, heat will have been excavated beneath a surface area of 7 square miles.

However, these thermal pits will not remain stationary. They will be swept from the project area toward the southeast to the vicinity of Hot Creek Gorge and the Fish Hatchery springs. The pits will migrate because they will move with the water that flows within the geothermal system. Data are not available to determine the rate of migration. However, based upon reasonable assumptions regarding the possible ranges of the determining factors, the pits probably will migrate at a rate between 50 to 500 meters per year. These rates translate into travel times of 80 and 8 years. Regardless of the rate of migration, however, the pits eventually will reach the Hot Creek Gorge and the Fish Hatchery springs.

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The mining of heat from the geothermal system will create a heat deficit in that system. That deficit ultimately will be manifested in part as decreased temperatures in the thermal component of the spring discharges. The heat deficit might be thought of as a "pollutant" within the natural geothermal system. The mining of heat by the projects will introduce the pollutants into the system. After project operations have been terminated, the pollutants will remain within the system until they are discharged from the geothermal system in the areas of natural thermal discharge, where the discharges include the convective heat flow from springs and conductive heat flow to the land surface.

The Draft EIR neither acknowledges this ultimate outcome nor attempts to analyze it in any meaningful manner. Crude models have been developed in order to predict the impacts of geothermal development on Hot Creek Gorge and the Fish Hatchery springs. However, these models do not represent the essential elements of the geothermal system with regard to the response of the system to development. The most important element is that the development and migration of the thermal pits is a transport phenomenon, and at least the migration of the pits must be treated explicitly as such in any model that is proposed as a tool for predicting the impact of geothermal development. A second element is that the

relevant transport processes occur within a particular hydrogeologic environment, and the model must incorporate information about the local properties of the hydrogeologic system. The existing models that were used in the preparation of the EIR incorporate neither of these essential elements.

The EIR is flawed both in the methods that are used and in the conclusions that are reached, and it should be rejected as a statement of the impact of development on the geothermal system.

2-15 From consideration of just the most basic physical laws of the conservation of mass and the conservation of energy, the only possible conclusions regarding the impacts are (1) that geothermal development will create thermal pits within the geothermal system, (2) that pits will ultimately migrate to areas of natural thermal discharge, and (3) that the temperatures or heat flux of the natural discharges will be reduced. These conclusions hold regardless of the conceptual model that is applied to the geothermal system. The issues represented by these conclusions are not addressed in the EIR.

Specific Comments

1. Page 4-36, Paragraph 2: The design of a viable monitoring program demands that the phenomenon to be properly monitored be properly considered. Owing to reinjection, significant pressure changes will not occur within the regional geothermal system. However, reinjection of colder water will create the

2-16 thermal pits that were described above. Once the pits are created, they cannot be removed in any practical manner. The pits will migrate within the regional geothermal system. Then, especially if the rate of migration is slow, all that a monitoring program will do is to track the inevitable migration of the pits to the areas of natural thermal discharge.

2. Page 3-40, Paragraph 1: Considering the cumulative impact of the PLES I project, together with other existing and proposed projects, the projects will produce thermal pits with a surface area of 7 square miles. This value is calculated by

2-17 assuming a rock-water heart capacity of 5.5 x 10 (5) calories per cubic meter,a thickness of 150 meters,a temperature differential of 100 degrees Centigrade, and a cumulative production over 30 years of 1.4 x 10 (17) calories. The conclusion is that the projects cumulatively will create very significant thermal pits within the natural geothermal system.

3. Page 4-41. Paragraph 1: The migration of the thermal pits to Hot Creek Gorge or to the Fish Hatchery springs does not

2-18 require an "extremely abnormal" flow pattern. It simply requires the consideration of alternative flow patterns. Nevertheless, the important fact is that the thermal pits

inevitably will migrate to the areas of natural thermal
2-18 discharge. That outcome holds regardless of the conceptual model or flow patterns that apply to the actual system and that outcome should not be in dispute.

4. Page 4-41, Paragraphs 3 and 4: Little is known about the large-scale bulk permeability of the geothermal system. Accordingly, statements about fluid velocities are merely speculations. The actual velocities easily could be an order of magnitude higher than stated and the travel times
2-19 concomittantly could be an order of magnitude shorter. Regardless of the fluid velocity, the thermal pits will inevitably migrate to the areas of natural thermal discharge. Furthermore, impacts will always be impacts regardless of the time at which they occur.

5. Page 4-43, Paragraph 2: The fact that impacts have not yet occurred is absolutely no evidence that impacts will not occur at some future time. The model calculations are no evidence that impacts will not occur because the models do not represent the essential features of the geothermal system.

Models can be valuable tools for the assessment of the impacts of development on the geothermal system. However, models easily can be misused by accident or for other reasons.
2-20 Models are nothing more than a formal statement of the modeler's assumptions regarding a specified system. If the modeler's underlying concepts of how the system behaves are incorrect or overly simplified, then the predictions that are made using the model will be incorrect. The art of model building is to identify the essential elements of the system and to incorporate those elements into the model. However, the models that were used in the development of the EIR are based on an overly simplified conceptualization of the system, and are therefore not valid predictors of the response of the system to development.

6. Appendix C, Page 32, Paragraph 3: The pressure-response and bulk models probably provide a reasonable gross assessment of the pressure effects within the geothermal system and of the initial development of the thermal "pits" within the vicinity of the reinjection wells. The heat-balance model can only
2-21 provide qualitative indications of the direction of long-term regional impacts, and it cannot produce quantitative predictions of the magnitude of the impacts. The problem with the heat-balance model is that it does not sufficiently represent the essential features of the actual geothermal system. Additionally, certain parameter values of the model (such as the reservoir volume) are difficult to assign

2-21 properly, and the quantitative predictions are sensitive to the selected values. To assess the long-term regional impacts, a more physically based model would be required.

7. Appendix C, Page 45, Paragraph 2: The block sizes that are used in the heat-balance model should be selected to encompass just the area over which temperature changes will occur. Likewise, the blocks should not include areas in which temperature changes do not occur. The block sizes used in the Papadopulos model assume that temperature declines will spread laterally over a width of about 1,300 meters. The heat-balance model that is described in Appendix C implicitly
2-22 assumes that temperature declines will spread laterally over a width of 3,700 meters. However, calculations in Appendix C using the bulk model state that the thermal front would spread laterally 800 meters. Therefore, the heat-balance model that is described in Appendix C is inconsistent with the bulk mode. However, the Papadopulos model is more consistent, but an even smaller reservoir volume might have been used in that model.

8. Appendix C, Page 46, Paragraph 1: Given the actual magnitude of the resource and the environmental constraints on its development, the combination for the existing and proposed projects taken together represent an unreasonable expectation
2-23 regarding the magnitude of possible development. The projects taken individually and in aggregate represent a significant risk to the environment and perhaps a significant risk in terms of economic viability of the projects.

9. Appendix C, Page 47, Paragraph 1: The results obtained with the heat-balance model that is described in Appendix C do not indicate what actually might occur within the geothermal system. The arbitrary use of a reservoir volume that is much too large results in computed temperature declines that are
2-24a much too small. As discussed in Item 7 above, the block widths should be equal to the width that will be affected by temperature declines. That width is significantly smaller than that which has been used in the heat-budget model described in Appendix C. Accordingly, the simulation results are meaningless regarding the magnitude of impacts.

Summary Remarks

Much has been made in the EIR and elsewhere of the controversy regarding the conceptual model that applies to the geothermal system. However, that controversy has little relevance to the
2-24b larger picture, because the general impacts of the projects will occur regardless of which model ("lateral flow" or "upwelling") properly describes the actual system. Most of the remarks that have been made above are not based on any particular conceptual

mode. Regardless of which conceptual model applies, the project will impact the areas of natural thermal discharge. The only relevance of the conceptual model to a discussion of impacts is
2-24c with regard to the temporal and spatial distributions of those impacts. Nevertheless, the total "mass" of the impact is independent of the conceptual model.

Assessing the Impact of Geothermal Development in the Casa Diablo Area on Spring-Source Aquatic Habitats and Wildlife

Natural resources potentially affected:

Although variability in surface flow rates and temperatures are natural for many thermal springs, the potential ecological effects of any permanent or transient changes in spring activity produced by geothermal fluid extraction need to be considered as an element of environmental impact assessment and monitoring. Geothermal development has an unknown impact on the uniquely adapted flora and fauna of local surface flows (hot springs, mineral springs, outflow ponds and marshes) that are supplied by the geothermal reservoir of the Long Valley caldera. The microbial, plant, and animal communities of thermal waters in this area have not been surveyed.

Unique and endemic species are often found in these habitat types because of the isolation of populations in small springs, and
2-25 adaptation to a narrow range of locally unique conditions (of temperature and mineral content). The inhabitants of these springs are primarily invertebrates, especially insects, but may include vertebrates such as fish and amphibians, and water birds that often feed at and nest around these habitats.

Some of the possible impacts of geothermal development include the loss of habitat and rare or endemic species if spring flows run dry, elimination of certain flow- and temperature-sensitive species if physical conditions change, and reduced habitat quality for birds and other vertebrate wildlife if the biological community of springs become less productive. In addition, pristine hot spring habitats, like other desert waters, are becoming more and more rare, and representative ecosystems need to be preserved as part of the natural heritage of this region.

Surveying the problem:

Before it is possible to develop a resource management strategy, it is necessary to survey and inventory the resource. The spring-source aquatic habitats of the Long Valley caldera include thermal and mineral springs, streams, and outflow marshes and ponds. These all may be directly or indirectly dependent on the geothermal reservoir as a water source. The objective of surveying these habitats is to establish what species are present, whether certain species or springs are rare or threatened by geothermal extraction, and how sensitive habitats may be protected. The scope of the survey should
2-26 include the following elements:

(1) Seasonal sample collections of invertebrates in all spring-source habitats identified in the area affected by geothermal development at Casa Diablo (species will be identified from these samples, and their prevalence recorded as common, rare, or endemic). Community composition may be used as a baseline for monitoring changes, and the presence of rare species used as a criterion for identifying habitats to be protected.

The area to be surveyed is essentially the same region as that proposed for monitoring under the USGS sampling scheme of Farrar and Sorey (1987). Integration of the surveys suggested here with the USGS hydrological monitoring program would provide a valuable bio-monitoring component to the system to detect changes in habitat quality and gaurd against the loss of sensitive and/or rare species.

The survey area should include:

* springs and geyser outflow at Casa Diablo
* Colton springs and Meadow spring
* springs in Fish Hatchery area, including Hot Bubbling Pool
* springs in Hot Creek Gorge area
* springs in Little Hot Creek Gorge area
* Big and Little Alkali Lakes
* Mammoth Creek (in Chance Meadow)
* Hot Creek
* Hot springs and outflows in Whitmore area

-26

These areas are all to the east and south of Casa Diablo, within the region expected to be influenced if lateral flow from the geothermal reservoir is the accepted hydrologic model. Sorey (1985) suggests that the shallow (500 ft depth) reservoir that supplies the geothermal fluid from which power is generated at Casa Diablo, continues eastward from this area, to Lake Crowley, dropping in temperature from 170 C to 70 C.

(2) Monitoring of temperatures and flows of surface waters to provide a baseline for assessing natural variation and changes due to geothermal development (the monitoring outlined by USGS).

(3) Determine temperature tolerance range for selected species in relation to natural variation and potential thermal changes associated with geothermal development.

(4) Collect field records of the usage of aquatic habitats by birds and other vertebrate wildlife.

References:

Farrar, C.D. and M.L. Sorey. 1987. Plan for hydrologic monitoring of thermal and nonthermal water resources of the Long Valley caldera, Mono County, California. Final draft report sent to Mono County Planning Commission, September 1987.

Sorey, M.L. 1985. Evolution and present state of the hydrothermal system in Long Valley caldera. J. Geophy. Res. 90:11219-11228.

Consultation and advice on these geothermal aquatic habitat surveys was provided by Dr. David B. Herbst of the Sierra Nevada Aquatic Research Lab (University of California). Dr. Herbst holds a degree in entomology and zoology, and specializes in research on the dipterans (flies) of desert waters, the most common group of invertebrates found in thermal springs. He has studied aquatic invertebrates of the Eastern Sierra and Great Basin for over 12 years. The Department of Fish and Game recommends that Dr. Herbst be given high consideration as principal investigator when such survey work is undertaken.

Attachment C

Specific Comments

1. Page ES-22: The value of the eggs at the Hot Creek Hatchery is in some ways undeterminable since many of the eggs produced there are of a unique strain and not replaceable at this time. The document states that the current market value is up to $16,000. This figure is incorrect. The current market value is approximately $250,000 if they were available. **2-27**

2. Page 1-3, Bottom Paragraph: We strongly disagree with the first statement in this paragraph. The Department position has been that an EIS/EIR must provide a thorough discussion of project impacts, mitigation measures, and a wide array of alternatives in order to fulfill the requirements of CEQA and NEPA. **2-28**

3. Page 1-6: The Department has also raised concerns over the loss of springs in the Casa Diablo area. **2-29**

4. Page 2-5, Paragraph 5: The statement that the project will avoid mature trees "whenever possible" is vague. For this mitigation to be feasible and effective specificity is needed. **2-30**

5. Page 2-5, Paragraph 8: The statement that pipelines will be buried or screened "as appropriate" is vague. Specific measures and locations should be described to mitigate impacts to migrating deer, visual quality, and other resources. **2-31**

6. Page 2-6, No. 12: The statement that ". . . noise intensive activities may be limited" lacks specificity. The deer migration periods should be extended from April 1 through June 30 and October 1 through November 30 to provide for known variability due to annual weather variations. The document should prohibit construction activities during these periods to provide allowance for the needs of migrating mule deer. **2-32**

7. Page 2-6, No. 13: Provides inadequate fencing specifications. This section should be reworded to provide for the needs of migrating mule deer. **2-33**

8. Page 2-7: The Department is not listed as one of the consulting agencies here but is elsewhere. **2-34**

9. Page 2-29, 2nd Paragraph: In this section, or elsewhere, the document should thoroughly discuss effects of trenching, retaining walls, pipelines, and all other project disturbances on migrating deer and measures to provide for deer passage in such areas throughout the project. **2-35**

10. Page 2-48, Impacts of Alternatives: Table 2.5 lacks discussion of project impacts and mitigation measures for two
2-36a biologically sensitive habitats present, the thermal marsh, and rhyolite buckwheat. Additionally, the description of impacts to migrating deer does not take into consideration
2-36b construction-related impacts and impedence of deer movements. The document does not give a specific reason why "No mitigation is recommended" for this project. Any suggestion that "new projects" in the future "could contribute to
2-36c off-site mitigation" does not exempt this project from its share of mitigation for adverse impacts. This Table is seriously flawed in many other aspects as well.

11. Page 3-20: This discussion leaves out the numerous thermal
2-37 springs located throughout the Long Valley KGRA.

12. Page 3-42, Paragraph 3 and Page 3-43, 1st Paragraph: The discussion regarding the migratory habits of the Casa Diablo
2-38 deer herd is incorrect. A portion of this herd is known to move through or very near the project area, as evidenced by sightings of marked animals.

13. Page 3-43, Paragraph 3: The Biotic Assessment (Appendix D) and the Deer Migration Study (Appendix E) reports do not agree
2-39 with the statement that "This deer movement does not appear to be concentrated in any localized portion of the survey area, but is dispersed throughout it."

14. Page 3-47: There are numerous mistakes in the list of Hot Creek Hatchery facts and information, such as: There are more than four state hatcheries in California. Add Madera County to the list of counties stocked with catchable trout. Under
2-40 natural conditions rainbow trout spawn in the Spring. Temperatures reported are not representative of actual source water temperatures. A temperature of 58°F would not kill eggs that were in incubators but would certainly affect eggs and sperm development prior to spawning.

15. Page 4-13: Mitigation Measures 2 and 4 require completion of a study, the results of which are not available to the
2-41 permitting agencies prior to certification of the document. In addition, moving the power plant to another site would require a new document.

16. Page 4-14: Mitigation Measure 5 is strictly a measure aimed
2-42 at reducing impacts to the project facilities after construction at the expense of increased environmental impacts.

17. Page 4-14: An impact to the project area through catastrophic
2-43 spill requires mitigation to offset the adverse environmental effects.

18. 2-44 Page 4-17: The listed mitigation measure is a reference to another document not readily available to the reader. Thus, one cannot examine its adequacy.

19. 2-45 Page 4-21, Paragraph 3: This section fails to adequately describe the impacts of noise created by the project. It refers to the closest sensitive receptors as the County office buildings. Department concern is for the on-site wildlife receptors of this noise impact, particularly mule deer. No mitigation of impacts to wildlife is proposed.

20. 2-46 Pages 4-29 and 4-32: The calculations presented on expected temperatures at Hot Creek, should a major spill of geothermal fluid occur, are wrong. In one case a mixed temperature of 100°F in Mammoth Creek produces a mixed temperature in Hot Creek of approximately 80°F. In the other case a higher mixed temperature in Mammoth Creek (118°F) produces a lower mixed temperature in Hot Creek (75°F) even though all other conditions remain equal.

21. 2-47 Page 4-30: The suggested mitigation refers to a later section, which turns out to be a bioassay study.

22. 2-48 Page 4-32: In this case the referenced mitigation measure does not even exist.

23. 2-49 Page 4-34: Impact does not identify habitat types which would be affected.

24. 2-50 Page 4-34: The effectiveness of Mitigation Measure 7 is based on information which is not available at this time.

25. 2-51 Page 4-35: The statement that "Shallow-rooted vegetation could be affected if drawdown of the local groundwater should occur from excess pumping at Casa Diablo" supports the Department concern that a substantial, but unknown, risk to wetlands exists. Any net loss of wetlands without compensation is contrary to Fish and Game Commission policy regarding protection of wetlands as well as Section 404 of the Clean Water Act. The document proposes no measures to prevent or offset wetland losses that could occur during the life of the project.

26. 2-52 Page 4-43: The stated impacts are based on a flawed conception of the resource in question. Please refer to Attachment A for a discussion on geothermal development in the Long Valley KGRA and the potential for project-related impacts.

27. Pages 4-47 through 4-56: Mitigation Measure 8 is largely a study aimed at determining when the impacts to the geothermal reservoir from project production activities will reach and impact critical spring flow areas. Within the study design there exists only cursory mention of ways to supply the Hatchery with hot water and the Gorge with makeup flows once these areas are impacted; however, these mitigation measures
2-53 are not presented in sufficient detail to allow decision makers the ability to make informed decisions. The proposed mitigation measures may induce to the system more impacts of the kind they are meant to mitigate. No mention is made of maintaining or restoring the temperature regime to the Gorge area once project-related temperature declines reach this valued resource. The Department finds the discussion centering around the monitoring plan to be inadequate in terms of meeting NEPA requirements.

Also mentioned in this section are two ways in which the project proponent could provide cool water to the Hatchery if water temperatures were to rise due to project power production. The first proposed method, that of drilling new shallow cold water wells, is completely unacceptable and in
2-54 fact was a major reason for the proposed Bonneville Pacific geothermal project. The second method proposed is to recycle water from Hot Creek as it leaves the Hatchery. This method is not as simple as it may appear. The water would need to be cleansed of excess nitrate buildup and reoxygenated. In essence, the water would need to be cycled through a tertiary water treatment plant. This measure is likely to be infeasible.

28. Page 4-56: Mitigation Measure 10 needs to be completed prior
2-55 to granting any permits.

29. Page 4-57: Mitigation Measure 11 does not compensate for the loss of heat due to project impacts. Hot water is the crucial
2-56 element necessary to support the public swimming area which attracts many of the people that make up the annual 95,000 visitor use days (a visitor use day is equal to 12 man hours of use).

30. Page 4-63, Paragraph 1: This paragraph is self-contradictory as evidenced by the statements that "No botanically sensitive areas and no riparian areas would be directly impacted by the proposed project." and "It is possible that botanically
2-57 sensitive rhyolite buckwheat areas could be damaged by activities near injection wells.". We believe that damage to both sensitive habitats (rhyolite buckwheat and thermal marsh) are likely project impacts. Page 4-65 (paragraph 2) admits the fact that cumulative impacts from other projects could be significant to riparian corridors and thermal marshes. The

2-57 proposed revegetation as mitigation for replacement of the sensitive thermal marsh habitat which will be irretrievably lost when surface hydro thermal flows are halted or degraded is inappropriate and infeasible.

31. Page 4-63, Paragraph 2: No specific mitigation is recommended to offset for "possible" damage to the sensitive rhyolite buckwheat ecosystem. Rather, several vague, unquantified and likely ineffectual measures are listed, such as ". . . care
2-58 should be taken to avoid existing vegetation whenever possible" (emphasis added), ". . . only minimum made to vegetation and soil would occur", and "Revegetation would be done as soon as practical" (emphasis added). These statements give the misleading impression of a benign project based on good intentions. This approach is contrary to NEPA and CEQA regulations and court interpretations which require that for mitigation measures to be effective they must be site-specific.

32. Page 4-64 to 4-65: The impact section does not recognize the
2-59 loss of thermal marsh (wetland habitat type) due to loss of thermal springs, and thus it is incomplete.

33. Page 4-65, Paragraph 2: Another example of inadequate impact analysis is presented here due to lack of discussion of
2-60 possible effects of dewatering of thermal and freshwater surface flows or resultant impacts to wetlands. The mitigation measure to require revegetation plans is unproven and nonspecific and therefore unacceptable.

34. Page 4-65, Environmental Consequences - Terrestrial Wildlife:
2-61 This entire section fails to meet NEPA and CEQA requirements by repeatedly citing unknown impacts to resources and by recommending either no mitigation or inappropriate, unproven, or infeasible mitigation.

35. Page 4-65, Bottom Paragraph: This section could be made accurate by restating that populations of wildlife dependent
2-62 upon sage brush scrub and Jeffrey pine habitats would be reduced commensurate with the loss of up to 13 acres of these habitats. No mitigation is recommended for this unavoidable habitat loss.

36. Page 4-66, Paragraph 1 and Page 4-67, Paragraph 3: This
2-63 section states that the effects of project noise on mule deer and songbirds cannot be known or predicted, and thus wrongly concludes, that no effects to populations will occur. A worst-case analysis is required for appropriate mitigation.

37. Page 4-66, Paragraph 2 and Page 4-67, Last Paragraph and Page 4-68, Paragraph 1: This paragraph contains several contradictions and unjustified conclusions. For example: If pipelines are aligned to funnel (trap) deer into impassable areas, what opportunity will they then have to avoid the project area? No mapping of pipeline configuration is provided. No attempt is made to preclude such deleterious, even fatal, trapping of deer by project facilities. This discussion then provides the irrelevant analogy of deer jumping eight-foot fences to reach succulent forage, ignoring the fact that the animals at Casa Diablo are not going to be willingly jumping to highly desirable feed but will be pregnant does under nutritional stress on a rigorous migration. The section also states "It is therefore likely that some, or perhaps many, of the adult deer could jump single pipelines along most of the length.". This statement does not take into consideration many adults and sub-adult deer that won't make it over the pipeline.

2-64

We do agree with the final three sentences in this paragraph - "However, there is no information available on how effective a deterrant the pipeline would be to normal migration or what the effect would be on pregnant deer in the spring migration or young deer in the fall migration. It is possible that some deer would be adversely impacted. Does carrying fawn may be more vulnerable to stress from disruptions.". Despite this information, no specific recommendations for mitigation are provided. Rather, the document provides the highly ineffective and vague measures to require ". . . below grade installation or screening of pipelines as appropriate" (emphasis added). Vague reference to fencing approval is also mentioned, meaning measures such as pipeline burial, crossing ramps, specified fencing designs, or the designation of an inviolate deer migration corridor (with Department and U.S. Forest Service input), or others are deleted.

2-65

Additionally, both wildlife studies (Appendices D and E) discuss several mitigation measures, none of which are incorporated into the proposed project design. Results of current, expanded deer surveys should be incorporated to more adequately describe the deer resource present. Due to the unknown nature of impacts, the document is required under NEPA and CEQA to display a worst-case analysis of impacts to mule deer.

38. Page 4-67, Paragraph 2: If fewer than 10 acres (e.g. 8 acres) of Jeffrey pine habitat is lost, then the wildlife using that habitat will also be lost. Thus, it is wrong to assume that no significant impacts to populations of residential species will occur. The Department considers significant over time

2-66

2-66 the annual loss of up to 10 summering mule deer does and their annual production of up to 15 fawns. Mitigation for this loss is warranted.

39. Page 4-68, Paragraph 2: This passage misinterprets the Deer Migration Studies (Appendix E). Kucera actually said that the initially proposed site, adjacent to the existing MPI plant, would have less impact on mule deer than the site now proposed in this document. This fact renders ineffectual the
2-67 mitigation to locate the plant as proposed in this document since that alternative does not represent a benefit to mule deer or other wildlife. In essence this section attempts to make the case that this proposal is self-mitigating regarding mule deer since this proposed alternative has lesser impacts than some other proposal having greater impacts without making a detailed analysis of both alternatives

40. Page 4-69, Section 4.2.2.5, Abandonment and Reclamation Impacts: The Department must conclude that ". . . The habitat
2-68 value of the site would be regained" only if all vegetation were guaranteed (by bonding, letter of credit, or other financial means) replaced in kind and quantity.

41. Page 4-69, Section 4.2.2.6, Cumulative Impacts: We find that habitat destruction will impact the species and that such loss
2-69 should be mitigated but not as vaguely proposed by "minimizing" timber harvest.

42. Page 4-69, Cumulative Impacts to Deer Herds: We consider cumulative impacts to deer to be significant and disagree that summer ranges will be unaffected due to project impacts on known summer/fawning use areas. However, winter ranges will be unaffected, but the disruption of migration routes will lead to deer population declines. The statement that the projects are in the "potential" migration routes is misleading because all data demonstrates these projects bisect the actual
2-70 migration route. Yet no on-site mitigation is proposed in terms of project design or other measures. The document, through the proposed mitigation in this section, attempts to relieve the current project of its specific mitigation responsibilities. In fact, the DEIS/EIR is entirely lacking a reasoned analysis of cumulative adverse impacts to migratory mule deer herds and is lacking any meaningful mitigation proposals.

43. Page 4-70, Mitigation of Cumulative Impacts to Mule Deer: This entire section proposes vague, ineffective, and
2-71 therefore, unacceptable mitigation measures such as: While it is reasonable to state that mitigation "could" be pursued by "regulating and limiting development", no specifics are given

2-71 regarding who will mitigate, where, or when such mitigation will be undertaken, or how effective such attempts are likely to be. What will be the resultant effect on the deer herds?

2-72 The proposals to acquire winter range and/or develop water sources on winter range have value for deer herd management. In fact, the Department is now proposing for state funding the installation of Casa Diablo winter range water sources, the acquisition of acreage at Swall Meadow, and the improvement of winter range condition in Round Valley. The Department must now question the effectiveness/appropriateness of these mitigation measures designed to improve winter ranges while at the same time impacts to the migration corridor and to summer/fawning habitat will be allowed to occur by new projects. In fact, improving winter ranges will not offset the effects of blocked or impaired migration routes. Further, if such measures were adopted, it must be stated that all costs are the responsibility of the projects creating the impacts. It is inappropriate to suggest that the public should fund mitigation measures necessitated by the profit-generating projects of private enterprise. Additionally, the document accurately cites the unknown effectiveness of the proposed measures (see Methow Valley Citizens Council vs. Regional Forester).

44. 2-73 Page 4-70: No mitigation was recommended for an impact to aquatic and terrestrial life impacted by geothermal fluid spills. Such mitigation measures as removal of sediment, habitat enhancement, increased angler use, and monetary compensation for recreational loss may be applicable.

45. 2-74 Page 4-83: No mention is made of the loss of hot water at the Gorge or the importance of this loss.

46. 2-75 Page 4-84: Loss of hot water at the Gorge is not mitigated.

47. a Page 4-90, Visual Resources: Our comments in the Department's Appeal on the FONSI for this project (Statement of Reasons) are hereby incorporated by reference. Specifically, we find unacceptable the planned reduction of visual quality along the State-designated scenic corridor of Highway 395. We conclude that such degradation will adversely affect fish and wildlife resource users as well as these resources. Additionally, we find the proposed measures to reduce visual impacts to be 2-76 vague and ineffective by employing such wording as ". . . will avoid mature trees whenever possible" (emphasis added), ". . . b partially or completely revegetated as soon as practical . . ." (emphasis added), "to the extent compatible with engineering. . . " and ". . . provide visual screening to the extent possible " (emphasis added). No meaningful, assured mitigation is recommended, and the discussion of cumulative visual impacts is inaccurate and cursory.

APPENDIX B

48. 2-77 Landscape and Revegetation Master Plan, Pages 4 and 5: This discussion stimulated thinking on a possible option for meaningful mitigation. The designation of a negotiated, inviolate migration corridor could partially offset project impacts. The value of such designated habitat could be increased through vegetation enhancement such as plantings of desirable plants, fertilization, irrigation, or other means.

49. 2-78 Page 6: The discussion of "trenching" is a logical place to mention pipeline burial or, at a minimum, the construction of sizeable earth ramps to facilitate deer movement.

APPENDIX D

50. 2-79 Biotic Assessment, Page 18, Paragraph 5: The mention of existing impacts to the thermal marsh ecosystem underscores the lack of and the need for more adequate discussion of cumulative impacts created by this and other development projects on botanically sensitive habitats and other natural resources.

51. 2-80 Biotic Assessment, Page 31, Paragraphs 1 and 2: This section provides possible measures to at least partially mitigate impacts to sensitive habitats. No such measures are mentioned in the DEIS/EIR.

52. 2-81 Page 31, Paragraph 4: This section reemphasizes the need for a cumulative study of projects in the Mammoth Basin vicinity and their impacts on the resources.

53. 2-82 Page 32, Paragraph 1: This section testifies to the "heavy" use by deer of a portion of the project site based on biological observations. It contradicts the Kucera (1987) report in this respect, creating a degree of uncertainty of impacts.

54. 2-83 Page 32, Paragraph 2: This discussion supports the Department conclusion of decreased wildlife populations resulting from habitat loss.

55. 2-84a 2-84b Page 32, Paragraphs 3 and 4: This discussion supports the Department conclusion of significant net impacts of construction and habitat loss to wildlife reproduction, including songbirds and mule deer. It also supports the need for specific mitigation for probable impacts of pipelines.

56. 2-85 Page 33, Paragraph 2: Our Appeal (Statement of Reasons) states that migratory deer are ". . . known to avoid areas of human occupation . . . high noise level, . . . (facilities)

2-85 with a high visual relief." We disagree that the animals "may habituate to any acceptable degree. Experiences at Colorado ski areas substantiate our position (Czencush, 1986).

57. Page 36, Paragraph 2: We agree that project facilities (especially pipelines) ". . . most likely will affect staging areas for the spring migration of mule deer . . ." and with the stated impacts to habitats, increased road kills, disturbance, and the stated potential cumulative effects, and
2-86a suggested mitigation measures. In spite of this valuable and objective discussion, the DEIR/EIR fails to recognize potential impacts or to provide meaningful mitigation measures for mule deer impacts. The discussion also describes deer use concentrated in the eastern and northern portions,
2-86b contradicting the Kucera report and emphasizing the need for the document to evaluate another viable alternative.

APPENDIX E

58. Deer Migration Studies, Kucera, Page 22, Paragraph 3: This
2-87 section suggests the need for a comprehensive, cumulative impact study.

APPENDIX F

59. Cumulative Development: This appendix, and the whole DEIS/EIR provide only a mere listing of area projects which can reasonably be expected to create impacts to resources. No reasoned impact analysis is provided. THIS DEFICIENCY IS
2-88a ESPECIALLY APPARENT IN REGARD TO MULE DEER AND OTHER WILDLIFE. On the final page of this appendix there is a lack of data necessary for cumulative impact analysis of effects to freshwater and thermal components of Hot Creek. This
2-88b justifies the need for a worst-case analysis.

END OF COMMENTS

United States Department of the Interior

GEOLOGICAL SURVEY

WATER RESOURCES DIVISION
Post Office Box 1298
Santa Rosa, California 95402

Telephone: (707)-576-1740

August 8, 1988

Mr. Curtis Milliron
California Department of Fish and Game
407 West Line Street
Bishop, CA 93514

Dear Curtis:

Water temperature measurements have been made at the Hot Creek Fish Hatchery H-2, 3 supply spring over the course of the last few years. Below is a tabulation of water temperatures measured in one of the source vents for H-2, 3. All the measurements listed were made by me, using care to take consistent readings in the same vent on each visit. All temperatures were measured with an ASTM certified laboratory thermometer except for the measurement on November 18, 1986 (in which case a thermometer tested for accuracy to 0.5°C was substituted). The temperatures measured with an ASTM thermometer are accurate to within 0.1° Celsius.

Date	Temperature (°C)
June 21, 1984	11.1
April 28, 1985	10.8
April 8, 1986	11.0
July 19, 1986	10.9
August 29, 1986	11.1
October 16, 1986	11.2
November 18, 1986	11.5 ± 0.5°C
April 21, 1987	10.8
May 27, 1987	10.8
June 18, 1987	10.8
July 28, 1987	10.9
June 2, 1988	10.8
June 3, 1988	10.8
June 21, 1988	10.9
July 11, 1988	10.9

2-89

As record becomes available from the Geological Survey's continuous water temperature monitor at the H-2, 3 vent, I will keep you informed.

Sincerely,

Christopher D. Farmer
Hydrologist

ATTACHMENT D

requires the Secretary of Commerce to obtain the views of Federal agencies affected by the program, including the Department of the Interior, and to ensure that these views have been given adequate consideration before approval of Coastal Zone Management Plans. The Service provides the Department's views about fish and wildlife resources. Pursuant to the Coastal Zone Management Act Amendments of 1980 (Pub. L. 96–464) the Department of Interior provides comments on Federal grants to help States protect and preserve coastal areas because of their ". . . conservational, recreational, ecological or aesthetic values." The 1980 Amendments also authorize the Department of Interior to enter into Special Area Management Planning to ". . . provide for increased specificity in protecting natural resources, reasonable coast dependent economic growth . . . and improved predictability in government decisionmaking."

Water Bank Act (16 U.S.C. 1301–1311). This Act requires that the Secretary of Agriculture ". . . shall consult with the Secretary of Interior and take appropriate measures to insure that the program carried out . . . is in harmony with wetlands programs administered by the Secretary of the Interior."

Wild and Scenic Rivers Act (16 U.S.C. 1271–1287). This Act requires the Secretary of the Interior to comment on such proposals. The Fish and Wildlife Service provides the Department's views with regard to fish and wildlife resources.

Geothermal Steam Act of 1970 (30 U.S.C. 1001–1025). This Act requires that the Fish and Wildlife Service recommend to the Secretary those lands that shall not be leased for geothermal development by reason of their status as ". . . a fish hatchery administered by the Secretary, wildlife refuge, wildlife range, game range, wildlife management area, waterfowl production area, or for lands acquired or reserved for the protection and conservation of fish and wildlife that are threatened with extinction."

Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201 et seq.). This Act requires the Department of the Interior to regulate surface mining and reclamation at existing and future mining areas. The Fish and Wildlife Service provides the Department with technical assistance regarding fish and wildlife aspects of Department programs on active and abandoned mine lands, including review of State regulatory submissions and mining plans, and comments on mining and reclamation plans.

Outer Continental Shelf Lands Act Amendments of 1978 (43 U.S.C. 1801). This Act requires the Secretary of the Interior to manage an environmentally sound oil and natural gas development program on the outer continental shelf. The Fish and Wildlife Service provides recommendations for the Department regarding potential ecological impacts before leasing in specific areas and contributes to environmental studies undertaken subsequent to leasing.

Mineral Leasing Act of 1920, as amended (30 U.S.C. 185). This Act authorizes the Secretary of the Interior to grant rights-of-way through Federal lands for pipelines transporting oil, natural gas, synthetic liquids or gaseous fuels, or any other refined liquid fuel. Prior to granting a right-of-way for a project which may have a significant impact on the environment, the Secretary is required by this Act to request and review the applicant's plan for construction, operation, and

We wonder why the obvious intent of this law was overlooked when the leases in Long Valley were being drafted. We frequently supply trout eggs from Hot Creek Hatchery to Federal hatcheries throughout the Nation.

(49 U.S.C. 1716). This Act requires the Secretary of Transportation to ". . . consult with the Secretary of the Interior with regard to the effect that any project . . . may have on natural resources including, but not limited to, fish and wildlife, natural, scenic, and recreation assets, water and air quality, and other factors affecting the environment . . .".

Department of Transportation Act (49 U.S.C. 1653(f)). This Act makes it national policy that ". . . special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges, and historic sites . . ." and requires that the Secretary of Transportation ". . . cooperate and consult with the Secretary of the Interior in developing transportation plans and programs that include measures to maintain or enhance the natural beauty of the lands traversed." The Department of Transportation projects using protected lands cannot be approved unless there are no feasible and prudent alternatives to avoid such use and, if none, all possible measures to minimize harm have been considered.

EXECUTIVE

President's Water Policy Message (June 6, 1978). This Message directs the Secretary of the Interior to promulgate procedures for determination of measures to mitigate losses of fish and wildlife resources.

Water Resources Council's *Final Rules; Principles and Standards for Water and Related Land Resources Planning—Level C* (September 29, 1980). These rules reiterate the importance of participation in the development planning process by interested Federal agencies, including the Department of the Interior. This participation includes review, coordination, or consultation

and Wildlife Coordination Act of 1958 (16 U.S.C. 661–664) (sic)."

Executive Order 11990—Protection of Wetlands (May 24, 1977). This Executive Order requires that each Federal agency ". . . take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for: (1) acquiring, managing and disposing of Federal lands and facilities; and (2) providing federally undertaken, financed or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation and licensing activities." Relevant wetland concerns and values include, but are not

SIERRA CLUB
CALIFORNIA

22 October 1988

RECEIVED
OCT 31 1988
GREAT BASIN
UNIFIED APCD

Mr. James S. Morrison, Area Manager
U.S. Department of the Interior
Bureau of Land Management
787 North Main Street, Suite P
Bishop, CA 93514

Dear Mr. Morrison:

Sierra Club comments on the Draft PLES I Geothermal Project Environmental Impact Statement are being submitted by Mr. Frank Stewart on behalf of the Toiyabe Chapter and by myself on behalf of the Sierra Club of California. My comments are as follows.

Despite its length, the Draft EIS is in many respects superficial in its treatment and it fails to address in requisite depth several critical issues upon which a responsible decision to permit or to deny the project depends. It displays a generally pro-project bias, and accordingly concludes that in most cases the project impacts would be insignificant. The reality of the matter as perceived by informed critics of the project is precisely the opposite.

These shortcomings, in our opinion, are attributable at least in part to the failure of your consultants, ESA, Inc., to respond in depth, or in some cases to respond at all, to the issues which we and other commentators identified in the scoping process prior to the preparation of the EIS. With specific reference to the issues identified in my own letter of 20 July 1988 in response to your solicitation of scoping comments (referred to as Letter and herewith attached), I would note the failure of the EIS to deal with the following.

1. Specific information should have been given in the project description (EIS, Section 2) relating to the proposed and alternate power plant sites. This should have included soil conditions including the proximity of hydrothermal fluids to the surface, geologic
3-1 structure including possible faulting and potential tectonic activity on the sites, slope, a plot plant of the proposed and alternate sites inclusive of elevations for cuts proposed, volume of soil to be removed, spoil sites planned, and width of roads. It is evident that none of this information is available and that the studies that would produce it have not been undertaken. Pages 4-12 and 4-13 reveal how provisional and contingent the proposed and alternate sites are in face of this lack of information. It
3-2 is acknowledged that a recent and possibly active fault may underlie the proposed site and that hydrothermal fluid may closely underlie its surface soils, and that the one could cause structural damage and the other could cause foundation problems. For both

[illegible] NINTH STREET, SUITE 20[illegible] SACRAMENTO, CA 958[illegible] (916) [illegible]

of these situations it is proposed to move the power plant site as a "mitigation". The author acknowledges that this could "adversely affect other resources", which seems to be a veiled way of saying that project impacts would change, which indeed they would if the plant were to be put in a different location. As for the alternative site given in the EIS, it is stated that that too may be underlain by an active fault, and there, also, the proposed mitigation is to relocate the power plant. A project simply cannot dealt with in this way under NEPA. The project location itself must be known and its conditions and its effects on the project must be known in all respects. The EIS cannot be completed until the plant site (as well as the sites for wells and all appurtenant facilties) has been finally determined and its suitability has been verified. Furthermore, it is then, and only then, that the impacts of the project can be adequately assessed and mitigations can be determined.

3-2

2. The EIS fails to identify the LongValley/Mammoth Lake/June Lake region as one of the most highly prized and heavily used recreational areas in the nation -- as the heartland of the Inyo National Forest, which enjoys over six million recreational visitor days per year -- and it fails to note that the proposed project as well as its proposed sister projects would constitute an expanding industrial complex at literal crossroads of and in the landing and take-off flight path for air travel to and from this region. A document which purports under NEPA to provide an objective evaluation of a proposed project on the human environment cannot avoid dealing straightforwardly with issues of land use conflicts and priorities of public benefit which arise in this case. This discussion, together with supporting documentation, should have been provided in the alternatives section of the EIS, with a specific consideration of the "no project" alternative as a means of protecting and enhancing recreational land use in the region. These discussion should have been documented with data regarding recreational visitor uses, habits and attitudes, projections for the recreational future of the region, and current recreationally oriented projects such as the Mammoth Basin Fisheries Management Plan being advanced by California Trout and the California Department of Fish and Game. The same factors should have been brought into the discussion of cumulative impacts.

3-3

3. It is evident to all parties that the major issue of public controversy over the proposed PLES I power plant project concerns the effects of the operation of this plant, together with other plants, on the hydrothermal reservoir and its naturally occurring discharges. It is, presumably, controversy over this issue, above all, that led to the decision to prepare an EIS. In light of this, it is incomprehensible that the preparation of the Draft EIS would have been brought to conclusion prior to the completion and full consideration of the major study of the reservoir being presently conduscted by S.S. Papadopulos & Associates, Inc. for the California Department of Fish and Game. This constitutes a serious failure to consider all relevant evidence in the preparation of the EIS, as required by NEPA, and ignores the policy established by the Mono County Board of Supervisors requiring comprehensive study of

3-4

further geothermal projects on the reservoir before such projects are undertaken (Minute Order 88-119, copy attached).

4. The EIS fails to answer a number of vital questions regarding proposed reservoir monitoring and management policies and techniques found in paragraph J of my attached letter of 20 July 1988. Unanswered questions remain as follows. Who will be the "Authorized Officer"? What are his qualifications to make the decisions for which he is given responsibility? Will he make these decisions alone, or with expert counsel? If the latter, how will this be guaranteed and who will these persons be? Will such decisions, the information upon which they are based and their criteria be open to public review and appeal? What opportunity will governmental agencies and interested parties have to participate in the decision-making process? What role will the Long Valley Hydrologic Advisory Committee play in the interpretation of data and in the design and selection of controls or mitigations to be employed? What are the operational rules of that committee? What authority does it have? What kinds of decisions can it make? Will temporary or, if necessary, permanent cessation of project operations be written into the project permit as a mitigation measure? Is this legally possible Is it politically feasible? Can possible effects on hot springs caus by one project (in thiscase PLES I) be differentiated from those of other projects to the extent that reponsibility can be assigned to one specific project? If not, does this not cloud the legal and/or political possibility of project production being terminated? What assurance can be given that hot springs and other naturally occurring hydrothermal phenomena can be restored, or will restore themselves, even if project operation ceases when changes are detected? If no su assurance is possible, how can the implementation of the PLES I or other projects be justified?

3-5

5. In its treatment of the visual impacts of the project the EIS fails to acknowledge or to take into consideration, as we requested, the refusal of the Mono County Board of Supervisors to permit the Mammoth Pacific II power plant on a site adjacent to the proposed site for PLES I because, among other reasons, of its "highly visible location near U.S. Highway 395 and the intersection of Hot Springs Road and the extension of State Route 203 (Minute Order 88-118, attached. The Supervisors also record similar findings with respect to the MP II plant in Minute Order 88-122 and with regard to the cumulative visual impacts of MP I, PLES I and MP II in Minute Order 88-121, also attached). The EIS also fails to respond to our observation that re reationists arriving in the Mammoth area by air will be introduced t their recreational destination by a close panoramic view of an industrial facility. We can imagine no possible mitigation for this impact (see Letter, paragraph G).

3-6

6. The EIS fails to address the issue of the quasi-permanent impacts on land form that would result from the implementation of the project and which would remain long after project abandonment. Restoration attempts would only partially erase the alterations affected by plant sites, roads and retention basins (see Letter, par. H)

3-7

7. Stream rehabilitation in the event of a major spill has not been addressed. Simply restocking with fish if a fish kill should occur (EIS, page 4-72) may not be enough and may be futile if the organisms upon which the fish depend for food supply have also been severely impacted. An adequately comprehensive stream rehabilitation program must be developed and proposed as a mitigation. Who will bear responsibility for such a program? Who will pay for it and how will this be assured? Will bonding for this purpose be required of the permittee? If not, why not? (see Letter, paragraph M).

3-8

8. The unique ecosystem of Hot Creek and its outstanding fishery and high recreational value is one of the priceless natural features of the Long Valley/Mammoth area. We have asked for and have not received a credible justification for subjecting these values to risk with the implementation of the proposed project. In fact, we have received no justification at all. We have only been assured that the risk is non-existent, but that if degradation should occur "thermal water shall be conveyed to the Hot Creek headspring(s)" This says nothing about the present natural mix of thermal and cold surface water, of the maintenance of the natural chemistry of Hot Creek, of possible effects which may occur in relation to the natural thermal discharges downstream in the Hot Creek Gorge, nor of degradation of the Hot Creek aquatic ecosystem. Nor does it assure who will supply hot water to Hot Creek and the Hatchery into the distant future. All of these together require discussion as a public trust issu

3-9

I emphasize the fact that all of these questions were asked by ourselves and by others during the scoping period and that they have not been answered.

Specific comments on the contents of the EIS are as follows.

page 1-10, second paragraph -- The dismissal of our assertion of the relevance of geothermal steam condensate spills at The Geysers to the presently proposed project at Casa Diablo has been endemic in these proceedings. Here it is stated in this EIS that ". . . over 80% of the Geysers spills are related to water cooling. At PLES I the geothermal fluid would be circulated in a closed system and the working fluid would be air cooled, so there would be no condensate nor would treatment of it be necessary". This statement completely misses the point! Whether this is by virtue of simple ignorance on the part of the author or whether it is by deliberate avoidance of the point, only the author knows. We ask you to read again and respond to the issue as stated in paragraph K of Letter, attached.

10

page 2-22, 2.1.5.1.1 -- It is stated that the mud pit will be lined. Presumably it will be lined in accordance with the specifications of the Regional Water Quality Control Board in conformance with the State of California Health and Safety Code.

11

page 2-27, 2.1.6.4 and 2.1.6.5 -- Where are the "some" areas located in which seedlings and larger plants will be planted? These are not identified in the Landscape and Revegetation Plan.

12

3-13 pages 2-10 to 2-18 -- The project description lacks specificity in a number of respects. In addition to a need for geological and soils data with respect to the proposed and alternate power plant sites (see pages 1 and 2 above), there is a need for the same information regarding each well site (page 2-11) and the O/CR building site (page 2-18). Is this information presently available for the well sites? If so, have these been finally established? If not, where may they be moved if the sites are found unsuitable? Where is the O/CR building to be located? It is a large building (up to 30' x 100'), and it will have its own impacts on the environment. These are nowhere described. On page 2-10 it is stated that the revegetation program will be evaluated after the

3-14 second year. Is this the only evaluation that will take place? The program should be evaluated every year for at least the first two years and then every two years with replanting as necessary.

3-15 page 3-17, first paragraph -- See comments on noise levels below in relation to treatment of noise impacts on pages 4-21 to 4-26.

3-16 pages 3-42 to 3-43 -- Tracking studies presently in progress and further evaluation of existing data may cause modification of the conclusions presented in these pages regarding deer migration through the project area.

3-17 page 4-3 -- The same mitigations for dust control should be applied during abandonment activities as during the construction period.

3-18 pages 4-6 to 4-8 -- Data and calculations for H_2S emissions figures and for maximum credible sustained flow from a blowout well (p. 4-7, first paragraph) should be given.

3-19 page 4-6, second paragraph -- What would H_2S levels be at the open fluid tanks? How can it be stated that H_2S odor would not be a nuisance to workers?

3-20 page 4-13 -- Mitigations 2 and 4 are not mitigations. They involve studies and planning that should have taken place before the writing of the project description.

3-21 page 4-14 -- The same as above is to be said of mitigation 5.

3-22 page 4-14 -- No mitigtations are recommended for the effects of volcanic eruption or of subsidence. It seems to us that prudent project planning would involve design features and contingency measures for the protection of the facilites as well as the environment from damage and spills resulting from these causes.

3-23 pages 4-15 to 4-16 -- The same comments as above apply to mitigations and the lack thereof, for the alternate power plant location as for the proposed location.

3-24 page 4-17 -- The mitigation for subsidence is not a mitigation but a recommended study.

pages 4-18 to 4-19 -- As noted above, the design and operation of the

containment basins seems very vague as they are presented in the Draft EIS. The Effectiveness/Impact analysis (top of page 4-19) of mitigation 6 is not reassuring. Dependence on manual closure of sluice gates in the event of a spill seems fraught with uncertainty. Cannot a more fail-safe procedure be devised? What does "No mitigation is recommended" mean following the Effectiveness/impact analysis?

3-25

page 4-19 -- It is evident that no drainage studies have been conducted for the alternate plant site. This should have been done so that its results clould have been integrated into the project description. From the map of the study area on page 3-36, the ephemeral lakes to which drainage from the alternate site may flow are outside the study area. Why is this the case? Their botanical and wildlife value should have been closely determined so that their sensitivity could have been accurately presented in the discussion of affected environment, and their protection detailed in the project description.

3-26

page 4-20 -- The statement of cumulative impact at the bottom of the page is misleading. While erosion from the PLES I site might be less than 2% of the total of all the projects named, the total will not all be directed toward Mammoth and Hot Creeks. Also, sources of data and calculations should be provided for numerical assertions of this kind.

3-27

pages 4-21 to 4-26 -- The noise section suffers the basic deficiency of failing to regard dispersed recreationists, passing recreational walkers, bikers and car travellers, and wildlife as sensitive receptors. The federal standard of 65 dBA is not satisfactory for this sensitive area. Due to the need for noise control in geothermal operations the Noise Element of the Lake County General Plan specifies 55 dBA (L_{dn}) in residential and other sensitive areas, and since 1984 the standard of 50 dBA has been applied by the Noise Control Officer (Draft Geothermal Resource & Transmission Element of the Lake County General Plan, Vol. 2 (dated 7/12/88)).

3-28

page 4-22 -- Instead of "No mitigation" for traffic noise from the project, car pooling or busing should be stipulated.

3-29

pages 4-23 to 4-26 -- The failure to specify mitigation for construction, well drilling and power plant operational noises from the proposed project is wholly unacceptable. Equipment mufflers, noise baffles, insulation and a variety of other means can be employed. Best Available Control Techology (BACT) as this has been developed for geothermal operations in The Geysers field should be used. Any location in the Inyo National Forest is a sensitive location because of the intermittent presence of sensitive recreationist receptors.

3-30

page 4-25 -- Noise impacts from PLES I are by no means diminished in their significance as seems to be implied by pointing out their incremental contribution to cumulative impacts!

3-31

page 4-27 -- The second sentence of the last paragraph is not clear.

3-32

page 4-34 -- Mitigation 7 is not a mitigation; it is a study.

3-33

3-34 page 4-43, last paragraph -- Is the monitoring program referred to as recommended for the project by LVHAC the same plan as that prepared and updated for LVHAC by C.D. Farrar and M.L. Sorey, May 1988? Is it this same plan that is represented in Table 2-4 on pages 2-30 and 2-31? Will BLM adhere to the Farrar/Sorey Plan in all respects? If not, why not, and what differences will there be?

3-35 page 4-63 -- The protective measures presented in the middle of the page are unduly vague: "whenever possible", "as soon as practical". Revegetation should take place during the year of construction, and operational limits should be staked on the ground for the protection of vegetation.

3-36 page 4-63, 4.2.1.2 -- Impacts on botanically sensitive areas should have been avoided in earlier project plannning.

3-37 page 4-64, 4.2.1.5 -- No mitigation is recommended, but it should be as a means of ensuring that the revegetation plan is successful.

3-38 page 4-66, first paragraph -- How is it known that to cause migratory deer to avoid the project area will not adversely affect the population.

3-39 page 4-66, middle paragraph -- Reference to the Sunset New Western Garden Book does not inspire confidence in the impact analysis undertaken in this paragraph. It would seem to us that much more specific information on deer movements than is reflected here is necessary, and that a specific layout design for buildings and piping relating to the facility must be developed in counsel with the Department of Fish and Game to provide uninhibited passage for migratory(and indeed locally moving) deer and to avoid funnelling effects where deer may be trapped.

3-40 page 4-71, top half -- No mitigtation is recommended for the protectio of the environment from hazardous materials, but it seems to us that an obviously necessary action is to design and specify safe storage and safe handling procedures for all such materials.

3-41 page 4-72, Mitigation 12 -- A bioassay is not a mitigation. The mitigation after the following paragraph (referring to mitigations (8), (9) and (10) in Section 4.1.4.3.1) is also not a mitigation, for the "mitigations referred to are monitoring and planning measures.

3-42 page 4-74, top of page -- There are no mitigations recommended in Section 4.1.4.1.6 as is claimed here.

3-43 page 4-84, top of page -- As pointed out above, the mitigations referred to in Section 4.1.4.3.1 are not mitigations, but studies. The same, again, it true of mitigation 12 on this page.

3-44 page 4-84, lower middle of page -- No noise mitigation is recommended but, as pointed out above, recreationists are sensitive receptors and mitigation is appropriate.

3-45 page 4-86, top -- Same comment again with respect to mitigations attributed to Section 4.1.4.3.1.

3-46 page 4-86, top -- It is stated, "no mitigation is recommended" if a spill and resulting fish mortality should occur. Why is this stated? Mitigation is obviously necessary.

3-47 page 4-86, middle -- The reasoning here seems to be faulty. Because a power plant is already near the proposed site and has attendant roads, transmission lines and tanks, the visual situation cannot be visibly worsened by introducing more of the same? As industrial development is expanded and also intensified in the Casa Diablo area it will certainly become more visually obtrusive (as well as obtrusive to ear and nose), and recreational experiences in the locality will certainly be less rewarding.

3-48 page 4-90, top -- No mitigation is recommended for the visual effects of drilling operations. At the very least it should be recommended that rig lighting should be shielded.

3-49 page 4-91, middle -- In the fifth listed impact-reducing measure the word "required" should be substituted for "encouraged" in the last line.

3-50 page 4-91, bottom -- It is stated that over a period of 10 to 15 years the VMO would be met in terms of project visibility. This means that the VMO will not be met until perhaps half way through the life of the project. This is not satisfactory.

3-51 page 4-95, second paragraph -- The reader is referred to Section 3.3.6.2 for existing visual intrusions from the view corridor toward Casa Diablo, but they are not described there. The sentence in which the reference is made is simply project serving. Because there are existing visual intrusions, more intrusions will not constitute significant visual impact!

3-52 page 4-95, middle paragraph -- We question whether the PLES I project can be called "light" industry.

3-53 page 4-102 -- If it is to be claimed that the County is to profit from tax revenues from the proposed project, a more detailed presentation of income and expenditure related to the project needs to be supplied.

I close with two general observations. First, the NEPA requirement for feasible and effective mitigation has not been met in this EIS. As noted throughout our comments, actions which are proposed for mitigations frequently are not mitigations but are studies instead, and we are often told that "no mitigation is recommended" in cases where mitigations are evidently needed.

Second, the treatment of cumulative impacts is regrettably fragmented, being accomplished by the inclusion of a brief paragraph at the conclusion of the discussion of each parameter of the anticipated impacts of the PLES I project. This fragmentation makes it impossible for the reader to gain a comprehensive understanding of the cumulative impacts and also prevents the author from presenting a comprehensive analysis. Further, the discussion is not infrequently focused in a

project-serving manner on the relatively small degree of impact that would be caused by PLES I as compared with all other projects together, including three other geothermal projects, skiing development, golf courses, hotels, and airport expansion within the Mammoth/Long Valley region. It must also be noted that except for water use and stream siltation the proposed recreational developments are not relevant to the required discussion of geothermal industrial impacts in this EIS, except that their existence serves to underline the pervasive and continually expanding recreational use and values of the region.

3-54 The treatment of cumulative impacts in this EIS is not adequate.

Sincerely yours,

Hamilton Hess
Geothermal Coordinator

255 Ursuline Road
Santa Rosa, CA 95403

cc: Ms. Ellen Hardebeck
Mr. Dennis Martin
Mr. Frank Stewart
Ann H. Lyons, Esq.

SIERRA CLUB 730 Polk Street San Francisco, California 94109 415·776·2211

JUL 25 '88

A
SRM
NRM
Administration
Geology
Recreation
VSS
Realty
Archaeology
Range
Maintenance
Fire
Wildlife
Files

20 July 1988

Mr. James S. Morrison, Area Manager
U.S. Department of the Interior
Bureau of Land Management
787 North Main Street, Suite P
Bishop, CA 93514

Ref. CA-11667
3200
(CA-922.5)

Dear Mr. Morrison:

A The Sierra Club applauds the decision of your agency to prepare and Environmental Impact Statement for the proposed Pacific Energy PLES I geothermal power plant project at Casa Diablo in the Inyo National Forest, and we appreciate the opportunity to submit comments relating to critical issues of our concern. Our comments are being submitted both by Mr. Frank Stewart on behalf of the Toiyabe Chapter of the Sierra Club and by myself on behalf of the Northern California Regional Conservation Committee.

B First of all, as we have consistently maintained in the past, we believe that this and other geothermal projects in the Long Valley area are inappropriate and ill-conceived. We believe, together with many other interested parties of record, that such projects will inevitably degrade the scenic, wildland quality of one of the nation's most prized and heavily used recreational areas (more than 6,000,000 visitor days in the Inyo National Forest annually; a higher number than the annual visitor days in Yellowstone and Grand Teton National parks combined) with the situating of a growing complex of industrial facilities at the very crossroads of recreational travel, both by road and by air, to and from the larger region and specific recreational sites within the region itself, and that they are potentially destructive of the unique Hot Creek ecosystem and fishery and threaten the continued operation of the Hot Creek Fish Hatchery of the State of California. For these major reason we are opposed to the project, for we remain unconvinced that adequate mitigations can be devised or guaranteed. At the very least, we believe that this project should not be allowed to go forward at this time. We believe that the Mono County Board of Supervisors acted wisely in denying the Mammoth-Pacific II power plant proposal -- a sister plant to the PLES I plant proposed -- partially, and significantly, on the grounds that ". . . no further geothermal development should be allowed in the Casa Diablo area, whether on lands under County, Town or Federal jurisdiction, until a comprehensive study has been done of the impacts of this project, all other approved or proposed geothermal projects and all other approved or proposed projects of any type which may affect the geology, hydrothermal characteristics, and general hydrology of the area." (Mono County Board of Supervisors, Minute Order 88-119, attached as Appendix A)

C We believe that on a scale of value the scenic, recreational and ecological assets of the area, which stand under threat of degradation, are vastly higher as a public benefit than the 10 or 20 or 40 megawatts of electricity that might be produced for thirty years by the proposed geothermal projects. This was also the opinion of the Mono County Board of Supervisors when they denied the Mammoth-Pacific II permit in asserting, "There are not benefits of the project sufficient to outweigh the unavoidable adverse impacts and that therefore a Statement of Overriding Consideration cannot be adopted and the project must therefore be denied." (Mono County Board of Supervisors, Minute Order 88-117, attached as Appendix B) The alternatives and cost/benefits sections of the EIS should address these issues forthrightly. From the standpoint of agency policy and action, would not the public good be better served by the Forest Service and the Bureau of Land Management supporting the Wild Trout Park proposal advanced by the California Department of Fish and Game, and by planning and promoting the scenic and ecologic integrity of the Long Valley/Mammoth Lakes/June Lake region as a formally designated National Recreation Area? These and other recreationally oriented programs should be discussed in the EIS for the Casa Diablo-Long Valley area as alternatives to the proposed geothermal electric program.

D At least three areas of informational deficiency exist relating to the preparation of the EIS. The first is in the lack of site-specific information regarding the location of the proposed PLES I power plant, pipeline routes, and perhaps in some cases the location of well pads. This lack of information precludes an adequate study of visual impacts, and of impacts on land, vegetation and water caused by cut and fill operations. The information problem is even more acute in relation to the alternative location for the plant proposed by the applicant at the scoping session on July 8th. We find ourselves incapable of offering any comments at all on the alternative proposal at this time, and request an opportunity for this when the exact alternative plant site, well pads and pipeline routes have been mapped and staked on the ground. We believe that such information and opportunity for public comment in review of the proposed alternative site is required for the EIS process under NEPA.

E The second major informational deficiency is found in the general agreement among experts that relatively little is known about the mechanisms and characteristics of the Long Valley hydrthermal reservoir and of the risk of degradation of naturally occurring hydrothermal features by the commercial production of hydrothermal fluids. A further major study of these questions is presently underway by S.S. Papadopulos and Associates, Inc. under the sponsorship of the California Department of Fish and Game. We request that the results of this study be incorporated into the analysis prepared for the EIS. While this would delay the preparation of the EIS beyond the time requested by the applicant, we believe that such delay would be reasonable, given the critical importance of the issue and the high level of public concern.

F The third informational deficiency relates to the migratory movements of mule deer through the project area. We agree with Finding R of the Mono County Board of Supervisors relating to the denial of the Mammoth-

Pacific II power plant project that "Testimony from representatives of the California Department of Fish and Game shows that this project willadversely interfere with the migration and survival of deer in the project area. Further study is necessary to determine whether the project can be constructed without such interference." (Mono County Board of Supervisors, Minute Order 88-123, attached as Appendix C) We believe that delay in the completion of the EIS is also justified by the need for the information to be obtained.

G Further analysis, conclusions and mitigations must be included in the EIS in relation to visual impacts. These impacts would be generated by the power plant itself, the cooling tower, night lighting, tanks and other appurtenant plant facilities, pipelines, drilling pads, sumps, retention basins, roads, parking lots, and electric lines. On page 4-46 of the original PLES I EIR/EA (prepared for the Great Basin Unified Air Pollution Control District) it is stated, "... even with mitigations, the plant would be noticed by casual observers and the Project would therefore be inconsistent with the Visual Management Objective of 'Retention'...". The proposed Mammoth-Pacific II plant which would have been closely adjacent to PLES I was denied by the Mono County Board of Supervisors for the following reason, among others: "Geothermal development at the proposed location of this project will create unacceptable visual impacts, which may adversely affect recreation and tourism and which will change the natural character of the environment in the area of the project. While the Mono County General Plan may encourage environmentally sound geothermal development, this Board is not required to and does not accede to this request to permit geothermal operations in the highly visible location near U.S. Highway 395 and the intersection of Hot Springs Road and the extension of State Route 203 where project construction and operation would occur". (Mono County Board of Supervisors, Minute Order 88-118, attached with Minute Orders 88-121 and 88-122 on the same issue, as Appendix) Both of these statements recognize the inherently unmitigable character of the visual intrusions of a geothermal electric power facility. In the case of PLES I (as in the case of Mammoth-Pacific II) the visual intrusion would be perceived not only from Highway 395, as the major route of travel in the highly scenic Long Valley area, but from Hot Springs Road, which is used as a route for recreational access, from higher terrestrial vantage points used by recreationists and sightseers, and from the air. Visual impacts from the air will likely be the most obtrusive to the recreationist whose inital close view of his recreational playground will be dominated by an industrial facility.

H Land form alteration for the construction of power plant sites, drilling pads, berms, sumps, retention basins and roads is not only visually obtrusive during the life of a geothermal project, but persists for an extensive period in human time beyond project termination and abandonment. While some aspects of such alteration can be erased by site reclamation, much of it will remain as an unnatural and undesirable, quasi-permanent feature of the landscape. This must be recognized in the EIS as an unmitigable and significant impact, and it must be credibly justified, if it can be, for imposition on a region valued for its natural beauty and high volume, constantly increasing recreational use.

I Recent studies of the hydrothermal reservoir underlying the Long Valley Caldera conclude that too little is known of its sources, mechanisms and characteristics to predict with any certainty what effects any single geothermal project, let alone all proposed projects together, might have on the naturally occurring hydrothermal phenomena within the region in general and upon the springs which serve the fish hatchery and which feed Hot Creek in particular. The unique Hot Creek ecosystem and its outstanding fishery and other recreational uses, together with the $20,000,000 value of the annual production of the State fish hatchery and the monetary value of the hatchery itself, are resources and assets of outstanding public benefit which would be put to appreciable risk with the implementation of the proposed PLES I and related projects. The EIS must give straightforward and credible answers to the following questions: What, if any, protective measures or mitigations can be employed to reduce this risk to zero? How feasible are they for actual implementation? What guarantees do they carry? If they cannot be guaranteed to reduce the risks to zero, how can the projects be justified? If they can be guaranteed and the guarantees fail, who is to pay for the damages or make other compensation if the damages cannot be remedied?

J Monitoring programs have been proposed in relation to the PLES I and other geothermal projects to determine the effects of project operations. Although they are important sources of data from which mitigations can be designed, monitoring programs are not mitigations. What specific monitoring programs will be used in relation to the PLES I project? Will the "Plan for Hydrologic Monitoring of Thermal and Nonthermal Water Resources of the Long Valley Caldera, Mono County, California, For the Long Valley Hydrologic Advisory Committee", prepared by C.D. Farrar and M.L. Sorey (Revised May 1988) be used as the primary monitoring plan? If not, why not, and what plan will be used instead? Who will interpret the data gathered by the monitoring programs relative to the PLES I project's effects on the hydrothermal reservoir and regional hot springs? Who will decide what measures are to be employed if detrimental effects are observed? Upon what objective criteria will such decisions be based? Will such decisions and their criteia be open to review and to appeal? What opportunity will governmental agencies and interested parties have to participate in the decision-making process? What role will the Long Valley Hydrologic Advisory Committee play in the interpretation of data and in the design and selection of controls or mitigations to be employed? What are the operational rules of that committee? What authority does it have? What kinds of decisions can it make? Will temporary or, if necessary, permanent cessation of project operations be written into the project permit as a mitigation measure? Is this legally possible? Is it politically feasible? Can possible effects on hot springs caused by one project (in this case PLES I) be differentiated from those of other projects to the extent that reponsibility can be assigned to one specific project? If not, does this not cloud the legal and/or political possibility of project production being terminated? What assurance can be given that hot springs and other naturally occurring hydrothermal phenomena can be restored, or will restore themselves, even if project operation ceases when changes are detected? If no such assurance is possible, how can the implementation of the PLES I or other projects be justified? (We attach as relevant material the

answers of Dr. Michael Sorey, U.S.G.S., to questions relating to the above at the February 22, 1988, Mammoth-Pacific II appeal hearing before the Mono County Board of Supervisors. The attachment is from the official transcript taken at that hearing and is herein included as Appendix E.)

K Surface water degradation from spillage of geothermal fluids and chemical materials is endemic to geothermal operations. Operational history in The Geysers field is illustrative of this fact (please see partial history of spills at The Geysers attached as Appendix F). The Geysers water pollution history has been treated as irrelevant previously in the PLES I proceedings (Final Environmental Impact Report PLES I Geothermal Development Project, May 1988, prepared for Great Basin Unified Air Pollution Control District, pages 4-26 and 4-27), but this is not so. It is argued that steam condensate is not produced from the PLES I project and therefore could not be spilled. The fact is that steam condensate is geothermal fluid which is frequently spilled at The Geysers and which the PLES I plant and any other plant in Long Valley would produce in abundance. It is a further fact that the fluid that would be moved at a geothermal plant in Long Valley is much greater in volume per megawatt than at a plant in the dry steam field at The Geysers. Spillable fluids at The Geysers occur as 20% of the steam condensate; the other 80% re-evaporates and the fluid portion is carried in one direction only, from the cooling tower to the injection wells. In a hot water field, as in Long Valley, the resource itself is fluid and it moved both to and from the power plant. Consquently, in Long Valley operations the fluid moved is eighty times the quantity per megawatt as at The Geysers (basic data: Geysers - 600 gpm of fluid to reinjection for 120 MW; Long Valley - 5,000 gpm of fluid x 2 (to and from the power plant) = 10,000 gpm for 12 MW). This means that one 12 MW plant in Long Valley together with the present MP-I plant will move almost exactly the same quantity of fluid per minute as is moved per minute in the entire Geysers field at it current 2,000 MW of production. The common causes of spillage of geothermal fluids are failure of valves and other fittings, pipe rupture (always a lurking threat in a tectonicaly active area), and human error.

L The introduction of geothermal fluids or chemical substances into Mammoth Creek and Hot Creek downgrade from the project area is totally unacceptable. Hot Creek is a world class trout stream and is also heavily used in its lower reaches for recreational bathing (80,000 visitor days per year). Its tributary, Mammoth Creek, also supports a fine trout population and is under consideration by the California Department of Fish and Game for nomination as a Wild Trout Park.

M At least six major questions arise from these considerations for treatment in the EIS. First, what have been determined to be the effects of geothermal fluid from the Long Valley hydrothermal reservoir through a range of temperatures and concentrations on trout and on the aquatic organisms upon which they depend for their food supply? Second, what measures will be required to be undertaken for stream rehabilitation if a major damaging spill should occur, and how effective would these measures be? Third, what protective measures will be required to prevent spilled fluids and other materials from entering

the surface waters? Fourth, how effective will these measures be? Fifth, what impacts will these measues themselves (retention basin, etc.) inflict upon the environment? Sixth, in the event of a major spill, who will be responsible, who will pay for the damage and cleanup, and how will this be ensured? Given the supreme value of the downstream waters, the power plant and related facilities must be designed, operated and guaranteed as a zero discharge operation. Sufficient bonding must be required of the permittee to cover the costs of complete stream rehabilitation in the event of unforeseen accidents.

N The problems of turbidity and stream bed siltation due to erosion arise as a second issue under surface water degradation. Erosion prevention measures, their effectiveness and feasibility need to be comprehensively treated in the EIS.

O Finally, in relation to surface water matters, a credible justification must be provided in the EIS for subjecting the Mammoth Creek and Hot Creek fisheries, recreational uses and ecosystems to the potential degradation which the implementation of the proposed geothermal project would involve. Will the public gain of 10 MW (net) for thirty years outweigh the potential public loss if periodic or chronic stream degradation should occur? Would even 40 or 60 MW as the possible productive capacity of the Long Valley area justify this risk in face of the fact that this area is also held in the public trust in perpetuity as an exceptionally valuable public recreation ground, with the Mammoth and Hot Creek fisheries and ecosystems as an important feature of its interest to the public? These large questions relating to the public good and to the inherent value of ecosystems (particularly unique ecosystems such as that of Hot Creek) in themselves must be dealt with fairly and credibly in the EIS.

P A full analysis must be made in the EIS with regard to recreationl values in the area, recreational uses, and recreational visitor habits and attitudes, the recreational future of the Long Valley/Mammoth Lakes area, and the relationship between recreational use and the proposed expansion of industrial use into the area in terms of compatibilities and conflicts. Acknowledged authorities on recreation in the area should be consulted and their knowledge and insights fully utilized. Among these are the Mammoth Lakes Resort Owners Association, the Mono County Chamber of Commerce, and the Sierra Club. One of the existing documents on the subject that should be consulted is "The Market for Summer Visitation to Mammoth Lakes and Mono County", December 7, 1987, prepared by Ragatz and Associates for the Mammoth Lakes Resort Owners Association.

Q As noted above, one of the reasons for the denial of the Mammoth-Pacific II power plant project by the Mono County Board of Supervisors on March 1, 1988, was the lack of available information relating to cumulative impacts that could be anticip ted with the construction and operation of the presently proposed cluster of power plants at Casa Diablo and downstream on Mammoth Creek. A realistic and comprehensive treatment of the cumulative impacts of these proposed plants and related facilities (all by the same applicant in the Casa Diablo area) must be preparedfor the EIS as a basis for a responsible final decision regarding the PLES I project. We are sure that you will agree. The parameters of the study should include visual, audial, olifactory

and cultural impacts, the pollution of surface waters, stream siltation, effects on the aquatic ecosystems and fisheries of Mammoth Creek and Hot Creek, land form alteration, fresh water supply, impacts on the hydrothermal reservoir, and effects on toursim and recreation.

R A credibly comprehensive cumulative impacts study takes time. Again, this will exceed the time frame for completion of the EIS process requested by the project applicant, but again we believe that delay in the completion of the EIS is justifed. The PLES I power plant is at this time the key geothermal project proposal in the Casa Diablo area. We believe, for all of the reasons given above, that it should not go forward -- that the project should be denied. But we also believe that if the PLES I plant is permitted the permitting of other current power plant proposals will likely follow, and that they should not follow without a comprehensive and accurate understanding of what the consequences are likely to be. All of these proposals with the exception of the Bonnevile Pacific project are being advanced by the same proponent, Pacific Energy. This is clearly the time for a comprehensive study of cumulative impacts to be made.

Sincerely yours,

Hamilton Hess
Geothermal Coordinator

255 Ursuline Road
Santa Rosa, CA 95403

cc: Mr. Frank Stewart
Ann H. Lyons, Esq.

Appendix B

OFFICE OF THE BOARD OF SUPERVISORS
COUNTY OF MONO
P. O. BOX 715, BRIDGEPORT, CA 93517
(619) 932-7911, EXT. 215

Nancy Wells
Clerk of the Board

MINUTE ORDER
88-117

TO: Sierra Club

FROM: Board of Supervisors

SUBJECT: Finding D, Sierra Club Appeal

At the regular meeting of the Mono County Board of Supervisors of

March 1, 1988, it was:

Moved by Supervisor Lawrence, seconded by Supervisor Stanford and unanimously carried to approve Paragraph (D) of findings "There are not benefits of the project sufficient to outweigh the unavoidable adverse impacts and that therefore a Statement of Overriding Consideration cannot be adopted and the project must therefore be denied."

Ayes: Supervisors Lawrence, Stanford, Thompson
Noes: Supervisors Alpers, Miltenburg
Absent: None
Abstain: None

Cc: County Counsel
Energy Director
Planning Director
Planning Commission
Mammoth Pacific Corporation

Directed to: Sierra Club

Response date: n/a

13
88-117

Appendix C

OFFICE OF THE BOARD OF SUPERVISORS
COUNTY OF MONO
P. O. BOX 715, BRIDGEPORT, CA 93517
(619) 932-7911, EXT. 215

Nancy Wells
Clerk of the Board

MINUTE ORDER
88-123

TO: Sierra Club

FROM: Board of Supervisors

SUBJECT: Finding R, Sierra Club Appeal

At the regular meeting of the Mono County Board of Supervisors of

March 1, 1988, it was:

Moved by Supervisor Lawrence, seconded by Supervisor Stanford and carried to approve Paragraph R of Findings, "Testimony from representatives of the California Department of Fish and Game shows that this project will adversely interfere with the migration and survival of deer in the project area. Further study is necessary to determine whether the project can be constructed without such interference.

Ayes: Supervisors Lawrence, Stanford, Thompson
Noes: Supervisors Alpers, Miltenburg
Absent: None
Abstain: None

CC: County Counsel
Planning Director
Planning Commission
Energy Director
Mammoth Pacific Corporation

Directed to: Sierra Club

Response date: n/a

13
88-123

Appendix D

OFFICE OF THE BOARD OF SUPERVISORS
COUNTY OF MONO
P. O. BOX 715, BRIDGEPORT, CA 93517
(619) 932-7911, EXT. 215

Nancy Wells
Clerk of the Board

MINUTE ORDER
88-118

TO: Sierra Club

FROM: Board of Supervisors

SUBJECT: Finding E, Sierra club Appeal

At the regular meeting of the Mono County Board of Supervisors of March 1, 1988, it was:

Moved by Supervisor Lawrence, seconded by Supervisor Stanford and carried to approve Paragraph (E) of Findings "Geothermal development at the proposed location of this project will create unacceptable visual impacts, which may adversely affect recreation and tourism and which will change the natural character of the environment in the area of the project. While the Mono County General Plan may encourage environmentally sound geothermal development, this Board is not required to and does not accede to this request to permit geothermal operations in the highly visible location near U. S. Highway 395 and the intersection of Hot Springs Road and the extension of State Route 203 where project construction and operation would occur.

Ayes: Supervisors Lawrence, Stanford, Thompson
Noes: Supervisors Alpers, Miltenburg
Absent: None
Abstain: None

CC: County Counsel
Energy Director
Planning Director
Planning Commission
Mammoth Pacific Corporation

Directed to: Sierra Club

Response date: n/a

13
88-118

OFFICE OF THE BOARD OF SUPERVISORS
COUNTY OF MONO
P. O. BOX 715, BRIDGEPORT, CA 93517
(619) 932-7911, EXT. 215

Nancy Wells
Clerk of the Board

MINUTE ORDER
88-122

TO: Sierra Club

FROM: Board of Supervisors

SUBJECT: Findings P, Sierra Club Appeal

At the regular meeting of the Mono County Board of Supervisors of

March 1, 1988, it was:

Moved by Supervisor Lawrence, seconded by Supervisor Stanford and carried to approve Paragraph P of Findings, "The proposed project will be located in an area which the USFS has assigned a Visual Management Objective of 'Retention.' Any change in the area noticeable to a casual observer would therefore be in conflict with this management objective. The power plant, even with all the mitigation measures, would be noticed by a casual observer and would therefore not conform to the requirements for the area. For that reason, and the reason noted in Finding O, the project is not acceptable."

Ayes: Supervisors Lawrence, Stanford, Thompson
Noes: Supervisors Alpers, Miltenburg
Absent: None
Abstain:None

CC: County Counsel
Energy Director
Planning Director
Planning Commission
Mammoth Pacific Corporation

Directed to: Sierra Club

Response date: n/a

13
88-122

OFFICE OF THE BOARD OF SUPERVISORS
COUNTY OF MONO
P. O. BOX 715, BRIDGEPORT, CA 93517
(619) 932-7911, EXT. 215

Nancy Wells
Clerk of the Board

MINUTE ORDER
88-121

TO: Sierra Club

FROM: Board of Supervisors

SUBJECT: Findings O, Sierra Club Appeal

At the regular meeting of the Mono County Board of Supervisors of March 1, 1988, it was:

Moved by Supervisor Lawrence, seconded by Supervisor Stanford and carried to approve Paragraph O of Findings "The draft EIR described the cumulative visual effect of the project in combination with the existing Mammoth-Pacific I project and the proposed PLES I as significant. The response to comments in the final EIR stated: 'The impact would be significant, even after mitigation.' This Board agrees and cannot therefore approve the project."

Ayes: Supervisors Lawrence, Stanford, Thompson.
Noes: Supervisors Alpers, Miltenburg
Absent: None
Abstain: None

CC: County Counsel
Planning Director
Energy Director
Planning Commission
Mammoth Pacific Corporation

Directed to: Sierra Club

Response date: n/a

13
88-121

SIERRA CLUB
CALIFORNIA

24 October 1988

Mr. James S. Morrison, Area Manager
U.S. Department of the Interior
Bureau of Land Management
787 North Main Street, Suite P
Bishop, CA 93514

Dear Mr. Morrison:

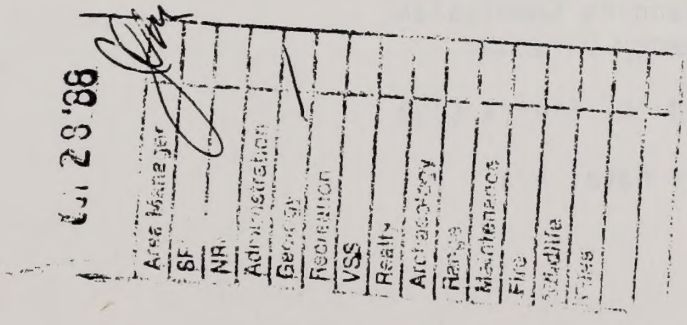
I enclose a sheet which should have been attached to the comments which I mailed to you today on the EIS for the proposed PLES I geothermal power plant. I would appreciate your allowing it to be so attached.

Thank you.

Sincerely yours,

Hamilton Hess
Geothermal Coordinator

255 Ursuline Road
Santa Rosa, CA 95403



OFFICE OF THE BOARD OF SUPERVISORS
COUNTY OF MONO
P. O. BOX 715, BRIDGEPORT, CA 93517
(619) 932-7911, EXT. 215

Nancy Wells
Clerk of the Board

MINUTE ORDER
88-119

TO: Sierra Club

FROM: Board of Supervisors

SUBJECT: Findings I, Sierra Club Appeal

At the regular meeting of the Mono County Board of Supervisors of

March 1, 1988, it was:

Moved by Supervisor Lawrence, seconded by Supervisor Stanford and carried to approve Paragraph I, of findings "Despite the discussion of cumulative impacts in the project EIR, which may be technically adequate for purposes of CEQA, no further geothermal development should be allowed in the Casa Diablo area, whether on lands under County, Town or Federal jurisdiction, until a comprehensive study has been done of the impacts of this project, all other approved or proposed geothermal projects and all other approved or proposed projects of any other type which may affect the geology, hydrothermal characteristics, and general hydrology of the area."

Ayes: Supervisors Lawrence, Stanford, Thompson
Noes: Supervisors Alpers, Miltenburg
Absent: None
Abstain: None

CC: County Counsel
Planning Director
Planning Commission
Energy Director

Directed to: Sierra Club

Response date: n/a

13
88-119

RECEIVED
OCT 25 1988
GREAT BASIN
UNIFIED APCD

Oct. 23, 1988

Bureau of Land Management
787 N Main St. Suite P
Bishop, CA 93514

Dear BLM-

I am writing in regards to the proposed PLES I geothermal power plant. I feel that this plant should not be built--the risk to both the fishery and the avifauna is much too great.

The thermal marshes surrounding the Long Valley hot springs are important wintering oases for many otherwise scarce bird species. During the 1987 Mammoth Christmas Bird Count birds such as the snowy egret and marsh wren were sighted in these areas. Dave Gaines wrote "East of the Sierran escarpment, wintering birds huddle near hot springs, as along Hot Creek (7000') and at Dechambeau Ponds (6500')" (Birds of Yosemite and the East Slope, Artemisia Press, 1988, p. 234). One of only two winter records for spotted sandpiper was at Hot Creek (Gaines p. 125).

4-1 Thermal marshes are rare and important in the eastern Sierra. Going north from Hot Creek/Casa Diablo, the next notable oasis is 40 miles away at Dechambeau Ponds. Due perhaps to grazing, few of the Long Valley thermal springs besides those in the fish hatchery/ Hot Creek area support the riparian vegetation necessary to maintain extensive bird life.

4-2 Furthermore, the PLES plant may jeopardize the production of trout at the State Fish Hatchery. Fishing is very important to the economy of Mono County. It has already been strongly impacted through water diversions and through eutrophication of Crowley Lake. As California's population continues to grow, quality recreation will become increasingly important.

Therefore, I urge you to deny a permit to the PLES I geothermal plant. Wildlife and fishing are more important to Mono County than another geothermal plant.

Sincerely-

Emilie Strauss

Emilie Strauss
POB 184
Lee Vining, CA 93541

cc: Great Basin APCD
Fish and Game

COUNTY of MONO

ENERGY MANAGEMENT DEPARTMENT

HCR 79, Box 221
Mammoth Lakes, CA 93546
(619) 934-6704, Ext. 403

DANIEL L. LYSTER
Director



OCT - 7 1988

GREAT BASIN
UNIFIED APCD

October 5, 1988

Ms. Ellen Hardebeck
Air Pollution Control Officer
Great Basin Unified Air Pollution Control District
157 Short Street, Suite 6
Bishop, California 93514

Dear Ellen:

The Mono County Energy Management Department has reviewed the "Draft EIS/EIR Supplement" for the PLES-I Geothermal Project, proposed to be located on federal land in Mono County, and would like to submit the following comments:

(1) **5-1** Acknowledging the need to consider the issues of fire safety, operational efficiency and the presence of heated soils below the ground surface, the feasibility of constructing the power plant upon an excavated pad site, below existing grade, should be evaluated. At the very least, the placement of the power plant should be done in a manner that maximizes "cut" and minimizes "fill" activities. Such practices may help to reduce the possible visual impacts associated with the siting of the power plant.

(2) **5-2** To the extent that slope stability and road access allow, the feasibility of placing the fluid conveyance pipelines in a lined trench should also be evaluated. In the event of an accidental geothermal spill, fluids could be easily directed into a sedimentation/containment basin via the trench system. Additionally, the placement of pipelines below grade would reduce their visual impact.

(3) **5-3** Based upon the information presented in Table 2-4, on Page 2-31, it is not clear whether the sampling frequency for Observation Well 65-32 is to be monthly or semiannually after the first year.

(4) **5-4** There is a discrepancy between the information presented on Page 3-47 and that presented in Figure 1-10 (Appendix C) regarding the natural variation of the temperature of

5-4 | the AB springs at the Hot Creek Hatchery during the period of 1976 to 1987.

Thank you for the opportunity to comment on this document. If you have any questions regarding this letter, please contact me.

Sincerely,

Dan Lyster

Dan Lyster,
Director
Energy Management

DLL/sc

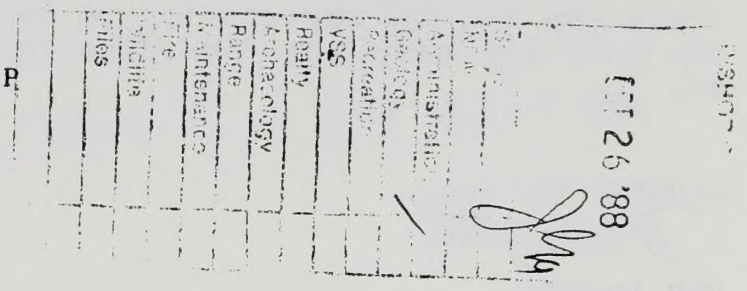
cc: Board of Supervisors

SIERRA CLUB

Toiyabe Chapter – Nevada and Eastern California

October 24, 1988

James Morrison
Area Manager
Bureau of Land Management
787 North Main Street, Suite P
Bishop Ca. 93514



Dear Mr. Morrison

We applaud the decision to prepare this EIS and Supplemental EIR. We feel that this action is in keeping with the intent of the National Environmental Policy Act, and the California Environmental Quality Act. It is unfortunate that it was necessary for the Sierra Club, Caltrout, Mono Wildlife Council, and the California Department of Fish and Game to use the appeals process to get this environmental review process moving in the right direction. Obviously, it would have been a better use of the resources of all parties concerned, if the lead agencies had simply taken this action initially, by preparing an EIS back in 1987.

We have reviewed the PLES Draft Environmental Impact Statement, and have the following observations.

NEPA section 1502.22, "Incomplete or unavailable information", states that information necessary to make a reasoned choice among alternatives must be considered in the EIS as long as the overall costs of obtaining it are not exorbitant. In order for the DEIS to comply with NEPA and CEQA regulations, numerous pieces of "incomplete or unavailable" information must be provided. The DEIS indicates on page 4-102 that the property value is expected to increase to $23 million as a result of construction of this project. A substantial investment. Compared to this amount, it would take a pretty good sized sum of money to qualify as "exorbitant". We do not see where the DEIS indicates that the costs to gather the information that we have referenced will be exorbitant, and we submit that the proponent has had plenty of time to do it.

6-1

This information, once it is present in the DEIS, will enable permitting agencies to make a fully informed decision regarding impacts to several natural resources, as well as choices among the various alternatives. If such information is not provided, then we believe that NEPA case law requires the development of "worst case scenarios" for impacts to resources.

In either case, until one or the other of these actions is taken, we must conclude that the DEIS, as written, is inadequate.

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One of the definitions of NEPA regarding the treatment of alternatives in the EIS is found under section 1502.14,

> "Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits."

This new DEIS reveals a couple of new alternatives not present in the original Environmental Assessment, those being the Alternative Location Action, and the Smaller Power Plant Alternative. The "Alternative Site Location" alternative in particular seems to suffer from a lack of "substantial treatment" in the DEIS.

6-2 Although it is very different from the preferred alternative, and although it may turn out to be an environmentally superior alternative, the basis upon which a reader could make such judgements is entirely lacking. For instance, compare the detail found in figure 2-1, and figure 2-6 site layout diagrams for each alternative. The lack of detail in the illustration for this new alternate location is obvious. The discussions of the alternate location as it relates to impacts and mitigations throughout the DEIS reflect this same treatment. A careful look at detailed mitigations is lacking.

The fabrication of workable mitigations is why NEPA requires that the EIS "rigorously explore" and "devote substantial treatment to <u>each alternative</u>". It is our opinion that this has not been done, and as a result, the "preferred alternative" is cast in a skewed and unrealistic positive light.

As for the other alternative, the "Smaller Power Plant Alternative", its inclusion in the DEIS seems to serve little purpose other than to give the impression that a "range of different actions" has been considered.

6-3 As presented in the DEIS the smaller power plant alternative is sort of a "tag along" to the preferred action..., being in the same location as the preferred action, and needing to construct very similar amounts of facilities, roads, wells and pipelines. Most importantly, this "similar design", as stated endlessly in the DEIS..., results in impacts that are "the same as for the proposed project". As we track this alternative through the document, we are shown that it is fundamentally the same as the preferred action, and so there is little need to elaborate on the few minor differences that surface. All the while the question at the back of our mind is "Is this project really a viable choice, given the fact that it is only 7 MW, and would therefore constitute a breach of the proponent's power purchase agreement"? (As pointed out on page ES-23)

This format has allowed the preparer to "fast-track" the preparation of this EIS, so that they may conform to the proponent's acknowledged pressured development agenda. This abbreviated consideration of alternatives does satisfy the intent of NEPA, and seriously undermines the legal adequacy of this document.

6-4 One last point regarding the treatment of alternatives, why was the original "Proposed Action" alternative of the EA/EIR dropped from consideration? From the standpoint of impacts to wildlife, it is a viable alternative and its absence contributes to the inadequacy of this document.

In conclusion, we believe that as written, the adequacy of this document pursuant to NEPA and CEQA regulations is questionable at best.

We have illustrated just a few of the deficiencies of the DEIS as it attempts to comply with NEPA regulations. We will illustrate others. We feel that, all told, these deficiencies are many in number and substantial in magnitude. In light of the underdeveloped action alternatives, and the missing or unavailable information, we are compelled to make the observation that this document is little more than the original EA/EIR with a new cover. It is our conclusion that this document should be withdrawn for the reasons set forth in this cover letter, as well as those that will be revealed in our written comments.

Therefore, we respectfully request that you resubmit this DEIS to Environmental Science Associates Inc. for further work. This work should include an expansion of the consideration of development alternatives, inclusion of the missing information necessary to make an informed decision, and the creation of true mitigation measures, the feasibility of which must be clearly demonstrated. This revised document should then be re-circulated for public review and comment as a Revised Draft EIS, Supplemental EIR. This would hopefully result in a document that will prove to be adequate under NEPA and CEQA guidelines. This procedure, painful as it may be, would clearly represent the most efficient use of the time of all parties involved.

6-5

Sincerely,

Frank Stewart

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cc: Dennis Ghiglieri, Chapter Chair
Hamilton Hess, Geothermal Coordinator,
Northern Ca. Nevada Regional Conservation Committee

Items underlined are done so by us for emphasis unless otherwise indicated.

INTRODUCTION/BACKGROUND

Page 1-3 appears to be a disclaimer as to the reasons for which an EIS was prepared. It should be noted that the public controversy over this proposed project goes far beyond the topic of "surface hydrothermal features". This point is clearly indicated by the BLM's request for remand which states,

> "The Bureau has concluded that the threshold of "significance" as defined in 40 CFR 1508.27 (b) (4) which would require the preparation of an EIS for the project has arguably been crossed as a result of the controversy surrounding potential project impacts".

Agencies, organizations, and members of the public expressed a broad range of concerns that covered the entire spectrum of issues found in the "Affected Environment" section of the DEIS. It is controversy regarding all of these potential impacts that has contributed to the crossing of the threshold of "significance".

2.1 PROPOSED ACTION

The DEIS describes a rationale for needing to construct a 15 MW plant in order to generate 10 MW "net". However, no data is provided as backup for this relationship. At what ambient air temperatures is it necessary for greater generating capacity to get to a 10 MW net production? Similarly, cooler winter temperatures will allow 10 MW of power to be generated while pumping smaller volumes of geothermal fluid.

6-6 The DEIS should provide the data and technical analysis used to support its contention under footnote /1/ on page 2-3,

> "Therefore the contractual obligation to supply 10 MW of power year-round would require construction of a plant with gross capacity of about 15 MW to compensate for parasitic uses and the lower summertime efficiency".

In the absence of this data, the determination that its necessary to build a plant with a gross capacity of 33% larger, is an arbitrary decision at best.

The Summary of Impacts and Mitigation measures in the Executive Summary states that the effect on the "Geothermal Resource Lease" of the smaller power plant alternative,

> "...would constitute a breach of the existing power agreement between the applicant and SCE and could result in termination of the project".

6-7 Isn't this very similar to the no action alternative? The DEIS should evaluate an alternative that varies the amount of geothermal fluid pumped with the fluctuations of the ambient air temperature. This alternative would be a realistic choice and would provide many of the possible benefits to the Hydrothermal Resource as the "Smaller Power Plant Alternative. Mitigations such as consideration of the use of "super insulated" pipelines may further reduce this volume of fluid pumped from the ground.

6-7 These analyses may reveal that less fluid than proposed is actually needed. We don't know either way based on what is contained in the DEIS.

Page 2-15, "Gathering System" describes the layout and construction techniques used in pipeline layout. Nowhere in this description does it say that there will be "underground piping". This is in conflict with Figure 2-1 which indicates that segments of the
6-8 pipeline will be "underground piping", as compared to being "below grade" in an open trench. The difference between these two will have significant detrimental or beneficial effects on migratory mule deer. This is also true of the description of the injection system described on page 2-21.

TABLE 2-4 HYDROLOGIC MONITORING PLAN

6-9 Colton and Casa Diablo springs should be monitored more often for temperature changes than the proposed once a month. Since these springs are so close to the production/injection field they will provide an early warning of pressure or temperature impacts migrating away from the powerplant. Therefore, temperature measurements should occur on a daily basis. Similarly, Observation Well 65-32 should be
6-10 checked for water level, temperature, chemistry, and isotopic analysis continuously throughout the life of the project, not just for the first year of operation. After all, we would assume that the proponent would continue to operate their power plant beyond the first year, and it seems reasonable that the level of monitoring should not taper off.

ALTERNATIVE LOCATION 2.2

Here again the DEIS states,

> "...it <u>may</u> be necessary to pump <u>approximately 10 to 20%</u> more geothermal fluid (up to a total 6,000 gpm) in order to compensate for temperature losses in the longer gathering lines and to generate more electricity to pump the fluid to and from the well fields."

6-11 The implication is that this greater volume of fluid will increase the potential of impact to the hydrothermal reservoir. Yet the DEIS provides absolutely no data to backup this vague contention. Without supporting data and technical analysis to back these contentions up, this statement is simply arbitrary and as such represents an alternative that is not fully developed.

Figure 2-6 illustrates this underdeveloped alternative concept quite well when compared to Figure 2-1 ("preferred alternative").
6-12 Compare the level of detail that each of these figures provides. Which portions of the pipeline in figure 2-6 are to be placed in "excavated trenches"? Where is section 2.1.7.9 that supposedly describes this pipeline construction detail?

6-13 It is unclear from examining figure 2-6 exactly which of the sections of fluid transmission lines for this alternative will be buried or subgraded to mitigate impacts on migratory mule deer. How can permitting agencies evaluate such potential impacts lacking such information?

If there were a generous use of techniques such as buried pipelines to reduce impacts to migratory deer, and if it were not necessary to pump so much more geothermal fluid to the alternate site location due to mitigations such as the use of "super insulated fluid transmission lines", then it is possible that this alternative could be mitigated enough to result in an environmentally preferable development alternative.

Apparently, as with the "preferred alternative", it is not proposed to bury any sections of pipelines to mitigate impacts to mule deer. All that is suggested is to subgrade those pipes in a trench. This is unsatisfactory. Pipelines should be completely buried at intervals of 300 feet to provide crossings for adult and juvenile deer. 6-13

Reinjection pipeline are routed through and adjacent to "Botanically Sensitive Areas" as identified in Figure 3 "Sensitive Habitats" of Appendix D. Why weren't these pipelines routed to the west side of the unnamed dirt road so that they would avoid these areas? 6-14

Page 3-36 Figure 3-5 Here is another example of the lack of detail in the DEIS for the "alternative site location". Why doesn't this map cover the areas occupied by all alternatives? 6-15

2.3 SMALLER POWER PLANT ALTERNATIVE

As we have said, the "smaller power plant alternative" seems to be in the DEIS merely to give the impression that a range of different actions has been considered. Its basis for being included in the DEIS is severely undermined in the very beginning of the document on page ES-23, where it is stated, and I quote,

> "The reduction in output to 7 MW would constitute a breach of the existing power agreement between the applicant and SCE and could result in termination of the project."

The solution for this dilemma is also found on the same page, to wit,

> "Approve the proposed project."

Now why consider an alternative that is doomed from the start? Another alternative suggested at the scoping meeting on July 8, 1988 was consideration of solar generated electricity to be produced by the proponent in a less sensitive location within Southern California Edison's grid. This alternative was not considered because, as is stated on page 2-1, 6-16

> "...the basic action under consideration by the BLM is not the generic generation of electricity, but the appropriate development of the federal geothermal lease."

Fair enough. Solar generated electricity is justifiably eliminated from consideration..., however, we submit that the consideration of a 7 MW plant, with its "Breach of Contract" dilemma, does not constitute an "appropriate development" of this geothermal lease. We feel that if it can be demonstrated that the smaller plant alternative is a realistic choice, then it should remain in the DEIS, however, as presented, it is an unrealistic choice, and should be eliminated as an alternative. ... Why was it considered? This superficial treatment of a non-viable alternative does not satisfy NEPA requirements.

ENVIRONMENTAL CONSEQUENCES

We object to the exclusion of the projects listed on page F-5 from the DEIS discussions on Cumulative Impacts. On the bottom of this page it states that treatment of these projects is not necessary due to the fact that they will not have the potential to consume significant or specific amounts of fresh water. Fresh water is but one resource value to be put at risk by the implementation of the PLES 1 project. We feel that this reasoning is extremely narrow minded due to the fact that the projects eliminated from consideration will combine with PLES 1 to potentially impact other resources from a cumulative standpoint. 6-17

The primary effects on resources of concern would include potential degradation of water quality, fragmentation of wildlife habitat, and degradation of visual resources. The Town of Mammoth Lakes Golf Course and the Doe Ridge Golf Course in particular, are legitimate candidates due to their potentially close proximity in Long Valley to the proposed PLES 1 project. This serious deficiency has allowed the DEIS to sidestep the majority of potential cumulative impacts as it focuses on those potential projects of its choice. As such, we feel that this treatment of cumulative impacts exhibits a blatant disregard for the intent of NEPA.

AIR QUALITY

Air Quality, pg. 4-2 DEIS states,

> "Disturbed areas would be revegetated, paved, or covered with gravel to limit long term dust generation".

This should be amended to indicate that this treatment will be applied to disturbed areas that are required for ingress and egress to maintain, operate or repair powerplant facilities. 6-18

ABANDONMENT AND RECLAMATION IMPACTS

Contained in this brief discussion is a cursory treatment of a scenario that could occur in the event of plant abandonment due to the project reaching the end of its useful life. It should be noted that reclamation would be required under other circumstances such as forced shutdown as the result of pressure/temperature impacts occurring that were attributed to the operation of the PLES 1 plant. Reclamation under these circumstances may well result in stressful financial conditions for the powerplant owners. 6-19

The DEIS supplies no data to aid in identifying what the potential costs of such a reclamation effort would be. In this area it is deficient as the costs would most likely be significant. To mitigate this the permitting agency should require the posting of an appropriately sized reclamation bond upon approval for construction, to be adjusted annually for inflation. 6-20

Possible plant abandonment as a result of resource exhaustion or forced shutdown, and the prospect of inadequate (or nonexistent) rehabilitation bonding may result in significant adverse environmental impacts. These impacts would include: 6-21

a) long term visual impacts as the result of abandoned power plant facilities, roads pipelines and unrestored cut and fill disturbed areas, or incompletely restored disturbed areas.

b) Potential contamination of shallow fresh water aquifers with geothermal fluids as the result of fractured casings in abandoned injection and production wells. One old capped well at the existing Mammoth Pacific unit I failed in Sept.29, 1984. 6-21

c) Siltation of Mammoth or Hot Creeks due to erosion of unstabilized soils in previously disturbed areas.

d) Pollution of Mammoth or Hot Creeks due to runoff from contaminated soils.

The DEIS should identify the projected amount of a of a rehabilitation or a restoration effort, and make a proposal for an adequate sized bond to be provided by the plant operators. In consideration of the scope of such a rehabilitation effort the DEIS should evaluate such things as;

a) Complete removal of all physical components of the project including power plant, electrical substation, fluid transmission lines, well pad facilities, electrical transmission lines, and paving or concrete associated with spill retention basins and building and pipeline foundations.

b) Fill wells with concrete or other suitable material to seal and cap. This will be necessary in order to prevent geothermal fluids from one aquifer from migrating into the shallow freshwater aquifer. This could occur as a result of fractures or breaks in well casings due to major seismic events.

c) Regrade to a natural condition, all previously disturbed areas such as roads, well pads, plant site, cut slopes, trenches, and spill containment basins.

d) Revegetate all graded areas with native shrubs and grasses in order to reduce visual impacts and replace habitat and forage for wildlife. Similarly, all former pastureland should be restored to the satisfaction of the grazing permittee. Given the area's short growing season an the low fertility of native soils, the revegetation program must be initiated with some form of irrigation and followed up with a monitoring and maintenance program to insure survival of vegetation.

GEOLOGY, SOILS, AND EROSION

On page 4-12 and 4-13 of the DEIS, there is reference to geotechnical studies that indicate that "a fault may pass through the proposed power plant site". Mitigation (2) page 4-13 is actually a proposal to do a study, it is not a mitigation. It reads,

> "Require investigation to locate and, if found, to date the suspected fault. Move the power plant facilities and wellheads to avoid siting on active faults."

6-22

The conclusions of that study may result in significant alterations to the project design as represented in the DEIS. If significant earthquake faults are found, how will permitting agencies determine if an alteration in project design is significant? This information should be present in the DEIS pursuant to NEPA section 1502.22 "Incomplete or unavailable information".

In the absence of such information, an informed choice of alternatives is not possible, since unknown (but suspected) earthquake faults may affect the ability of proponents to locate project facilities in the areas illustrated in the figures of the DEIS.

6-22 We submit that to satisfy the intent of avoiding an adverse impact caused by an earthquake fault, this study should be done and be appended to this DEIS. The cost of such a study would not be exorbitant, given the scale of costs necessary to implement this powerplant facility. In fact, what appears to be the precise study in question is currently already underway.

In response to a "Freedom of Information Act Request" sent to Mark Ziegenbein BLM Bishop Ca. (Certified Mail, Return Receipt Requested #P466423409 10/13/88) we were told that, although proprietary, there are indeed investigations of this type currently underway in the Mammoth Pacific unit II and PLES unit I areas. (Ziegenbein, personal communication 10/19/88). They include both physical trenching studies, as well as Resistivity Surveys.

We conclude that this is clearly an example of incomplete information, and that the referenced study should be carried out as a part of the DEIS. This will enable permitting agencies to make a fully informed decision regarding power plant facilities siting so that they do not overlay earthquake faults in the Casa Diablo Area.

Mitigation (4) on page 4-13 suffers from the same ailment as (2) above. This is a promise to do a study to verify that high groundwater levels will not interfere with project construction. The results of the proposed studies may again result in moving project facilities to other locations.

This data will presumably inform someone (permitting agencies, the developer?) as to the level of groundwater at the power plant site that may in turn affect grading plans or facilities locations. Such

6-23 information should be a part of the DEIS. Future changes in project design that may result when these studies are done may significantly alter one or more of the alternatives as presented in the DEIS. Given the high sensitivity for not impacting other resources (such as visual), we feel that shuffling around project facilities to avoid impacts revealed by these studies is also a sensitive issue. We do not believe that NEPA intends for permitting agencies to have such broad discretion to alter a project after an EIS has presumably been certified.

These are just two examples of "incomplete information". We belive that this lack of information in the DEIS has resulted in the inability of permitting agencies to make a fully informed decision. We do not see where the DEIS indicates that the costs to gather this information will be exorbitant. The suggestion that project layout can be adjusted later on is founded on questionable legal grounds.

WATER QUALITY AND HYDROLOGY

4.1.4.1.6 Cumulative Impacts.

It would be helpful in this section for the purposes of assessing cumulative impacts to water quality to identify the mixed water temperatures in Mammoth and Hot Creeks as they relate to the volumes of spilled fluids that could be released from MP 1, 2, 3, and PLES 1. This type of event could occur due to seismically induced pipeline ruptures which would presumably affect all powerplants if they affected one. Under these circumstances, it is probable that the mixed water temperature calculations found on pg 4-32 would be altered significantly. Under this scenario, we feel that this comprises another example of incomplete information, NEPA 1502.22. 6-24

DEIS page 4-32 bottom; where is Mitigation (10) for this impact? Mitigation (12) is actually a call for another study,

> "Bioassay would be required under the revised Plan for Baseline Data Collection.

A bioassay is not a mitigation for impacts to streams resulting from spills of geothermal fluids. It is a tool for evaluating the effects of those spills. We found an attempt at proposing an adequate mitigation for this impact on page 4-72, 6-25

> "If project operations caused mortality to fish in Mammoth Creek, Pacific Energy has agreed to fund restocking of the affected reach".

We made a clear point of the inadequacy of this type of mitigation in our scoping comments (see pages 16, 17) and refer to it by reference. The feasibility of this mitigation is questionable. The DEIS fails to demonstrate that hatchery reared trout put in a stream that has been scoured of insect and invertebrate life will reproduce to re-establish the wild trout population that currently resides in the creeks in question. 6-26

Although a Bioassay is not a mitigation, it would identify the relationship between geothermal fluid and toxicity to aquatic organisms. In our scoping comments 4/16/88 for the DEIS, we specifically requested such a Bioassay,

> "The DEIS should contain a bio-assay that identifies the tolerances of freshwater vertebrates and invertebrates to various temperatures and concentrations of geothermal fluid. this information would be very valuable in assessing potential adverse impacts to aquatic biota in the event an accidental spill of geothermal fluid reached Mammoth Creek. Of particular interest would be the insects that make up the food chain that supports the wild trout populations in Mammoth and Hot Creeks". 6-27

Why isn't this bioassay in the DEIS? In our scoping comments, (see page 15), we pointed out that Hot Creek is the most biologically productive wild trout stream in the state of California. Such productivity may be difficult, if not impossible to replace or recreate. We protest this treatment of our concerns for the aquatic ecosystem of Mammoth and Hot Creeks as it relates to the DEIS and its deficiency in gathering information regarding the effect of spilled geothermal fluid on that ecosystem. Surely the proponents' claims that they can design a virtually "fail-safe" spill retention system and culvert shutoff valve cannot be accepted as reason enough to ignore this concern. We could find no technical appendices that provide evidence that such a shutoff valve exists, or has been tested in an environment that matches the winter and summer conditions existent at the project site. 6-28

The DEIS should identify a specific size of bond for the protection of these aquatic resources. The draft permit conditions
6-29 for the Bonneville Pacific proposal specified $500,000 for such a bond, and we feel that although this is not large enough to offset total losses of Mammoth and Hot Creek, it is at least a start.

Page 4-34, Mitigation (7) is not a mitigation. As phrased, the ability of using reclaimed wastewater for revegetated areas is dependent upon "unknown" factors that govern "economic and technical
6-30 feasibility". This referenced evaluation should be a part of the DEIS so that if irrigation with wastewater is feasible, it can be incorporated as a permit condition. As stated, this promise does not qualify as a mitigation, and merely serves to cast the project in a positive light.

Pages 4-47 to 4-51 describes what is being represented as a mitigation for adverse impacts to the Hydrothermal reservoir. Condition b, pg. 4-48 states,

> "A second monitoring well shall be drilled prior to the start of commercial production and subsequently maintained in conformance with the requirements of stipulation (a). The well shall be sited at a location to be determined by the Authorized Officer and the appropriate governmental agencies with land use jurisdiction".

6-31 Our contention has long been that the validity of monitoring data depends on pre-operational monitoring that is unskewed by commercial production and extraction of geothermal fluids. The DEIS is unclear how soon "prior to the start of commercial operation" this monitoring well will be put into place. This point is very important when viewed in light of the fact that proposed "trigger points" for production curtailments are nothing more than ranges of temperatures and pressures that are to be measured over time. If the time frame for measuring these swings is coincidental with the start-up of commercial production, then it may well be that pressure/temperature fluctuations that are the direct result of plant operations will be built in to the so-called "baseline data". PLES proponents have had ample time during the course of these proceedings to implement a monitoring well

This lack of specific parameters for implementing modification in project operations results in the granting of limitless discretion powers to the permitting authority. This situation undermines the feasibility of proposed mitigations regarding adjustments of injection and production schemes, as well as curtailment or cessation of plant operations. Such mitigation measures appear lengthy on the surface, but upon closer inspection, are quite vague in content. We reiterate
6-32 the concerns that we brought forward on this topic in our scoping comments for the DEIS,

> "Another component of the monitoring program should include a detailed legal description of what would occur in the event pressure-temperature impacts were detected. This description/evaluation should be provided by legal counsel retained by the preparers of the DEIS, that would answer some questions likely to be asked surrounding this issue. As an example, curtailment or cessation of operations has been suggested as a mitigation regarding such impacts.

6-32 What is the trigger point (in terms of change in pressure or temperature) at which plant shutdown and/or curtailment will occur? Who will be consulted in determining that curtailment is necessary? What is the "chain of command" that will have the authority to implement curtailment? How will federal permitting agencies avoid litigation in the event that there is a dispute over who has caused an impact that surfaces at Hot Creek or the Hatchery?"

The DEIS has ignored these concerns, and these questions remain unanswered. The closest the DEIS has come in being specific on this matter is represented on page 4-53,

"Monitoring results from MP I and PLES I production wells would be analyzed to detect changes in pressure, temperature, and/or chemistry outside the range established as normal based on previous experience".

6-33 Those words are far from specific, propose no criteria for initiating mitigations, and represent a significant, and legally questionable loophole. In this case, the DEIS has not demonstrated feasibility of its proposed mitigations. They sound good on paper, but in the real world, we believe them to be unworkable. Furthermore, all of these mitigations are structured in such a way as to detect effects on hydrothermal features after the effects have occurred. In and of themselves, they only serve to detect changes, but cannot be shown to

6-34a be effective in preventing adverse impacts to the hydrothermal system. Mitigations should go far beyond merely detecting changes, rather, they are defined by NEPA section 1508.20 as,

"a) Avoiding the impact altogether by not taking a certain action or parts of an action".

Curtailment of plant operations occurs after the fact, it does not avoid the impact. The only mitigation that the DEIS contains to avoid impacts to the hydrothermal reservoir is the No-Action alternative.

"b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation".

The only mitigation that may accomplish this is to choose the "smaller plant alternative", even if it would result in "breach of the existing power agreement between the applicant and SCE". NEPA is unconcerned with power purchase agreements of the project proponent. NEPA is concerned with impacts to the environment.

"c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment".

Appendix C BGI report, upon which the discussions of hydrology are based contains a curious disclaimer on page 31,

"Potential impacts of geothermal power production on surface thermal fluid resources (springs and other manifestations) near the Casa Diablo Area are difficult to predict precisely without a more thorough understanding of the geothermal reservoir. Additional drilling testing and analysis of the region would assist in evaluating potential adverse effects on springs".

This language sounds as if it were written by someone's legal counsel. In order to have confidence in the proponents ability to "rectify, repair or restore the affected environment" of thermal features, it follows that the BGI report should contain language more like, "...given existing knowledge of the geothermal reservoir, it is easy to predict precisely...".

6-34b

"d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action".

See discussion above.

"e) Compensating for the impact by replacing or providing substitute resources or environments".

We feel that the natural environment of the hot springs and fumeroles in the Hot Creek Gorge, or other thermal features in the Long Valley Caldera, are unable to be "replaced with substitute environments". Page 4-54 DEIS fails to describe any such mitigation proposals, its focus is clearly aimed at the Owens Tui Chub habitat contained in the Hot Creek headwaters, and the thermal component of the Hot Creek Fish Hatchery. Both are valuable resources that could be affected by thermal impacts, but they are clearly not the only thermal features with which we are concerned.

That being said, the discussion of the Mitigation Measures described for "step 6", page 4-55 DEIS is cursory at best, and as such does not comply with the intent of NEPA. Such a mitigation plan may take on the scope of a completely new project in terms of design, agreements between holders of private property rights, permitting agencies, and governmental jurisdictions. Its feasibility is unproven, and we believe that further analysis would demonstrate the potential for various environmental impacts.

6-35

We believe that the hydrologic monitoring program in its entirety and including all proposal as identified in the DEIS, will not satisfy the intent of NEPA regarding the need for mitigations to protect the Hydrothermal Resource. Its primary focus is "detection", and its reinjection scenarios are mere hypothetical solutions cast against an appendix whose authors are only willing to go so far as to say that it is "difficult to predict" the effects of commercial production on the fluid reservoir.

6-36

The monitoring plan's "progressive nature" only serves to illustrate that resource managers will follow impacts around the Long Valley Caldera as they drill their different monitoring wells. Accessibility and permission to drill monitoring wells in the areas indicated have not been demonstrated.

Finally it is arguable whether proposed wells will detect changes against a background that is skewed by commercial production.

In conclusion, it is the concern for potential adverse impacts on the Hydrothermal Resource which led the Mono County Board of Supervisors to adopt Minute Order 88-119 as they denied the use permit request for the Mammoth Pacific Unit II Geothermal Plant,

> "Despite the discussion of cumulative impacts in the project EIR, which may be technically adequate for the purposes of CEQA, no further geothermal development should be allowed in the Casa Diablo area, whether on lands under County, Town, or Federal jurisdiction, until a comprehensive study has been done of the impacts of this project, all other approved or proposed geothermal projects and all other approved or proposed projects of any other type which may affect the geology, hydrothermal characteristics, and general hydrology of the area".

This minute order was drafted with the full knowledge and benefit of an extensive public record that included testimony by experts in the field of hydrology.

It was also drafted with full knowledge and benefit of the stipulations contained in Conditional Use Permit No OIE-86-02 which contains a section titled "Hydrology and Water Quality". The conditions contained in this section of the draft use permit pertain to monitoring the hydrothermal resource, and are quite similar to those contained on page 4-43 to 4-54 of this DEIS.

Finally, this minute order fully intended to include the PLES project in its reference to "no further geothermal development" on private lands or lands under "Federal jurisdiction" pending the outcome of this "comprehensive study" which would identify the cumulative hydrological impacts of all these potential projects combined. We believe that the BLM should, in deference to this decision of the Mono Board of Supervisors, make an identical finding, and join in cooperation with other jurisdictional and resource agencies in the implementation of this study. Additionally this study should include other critical resources in Long Valley, such as mule deer.

6-37 In conclusion we wish to incorporate by reference into these comments IBLA Appeal #11667 filed by the Sierra Club, California Trout, and the Mono Wildlife Council. It was in the face of this appeal that the BLM requested that the Interior Board of Land Appeals remand the appeal back to the BLM for preparation of this EIS.

In this appeal, the point is clearly made that monitoring of itself does not constitute mitigation. In our written comments, we address this issue pursuant to NEPA section 1508.20 and we strongly encourage permitting agencies to evaluate that discussion very carefully.

The basic premise in the monitoring plan that a hydrologic impact can be reversed is based on projections contained in Appendix C of the DEIS. Consultants retained by the California Department of Fish and Game are drawing far different conclusions than those contained in Appendix C.

One thing is clear, both studies are hypotheses, neither can offer conclusive proof. This serves to illustrate that the "feasibility" of proposed schemes in the monitoring program of the DEIS is unproven.

TERRESTRIAL WILDLIFE

6-38 The PLES project as proposed in the DEIS is not in compliance with the existing Deer Herd Management Plans for the Sherwin Grade, Buttermilk, and Casa Diablo Deer Herds. These plans were jointly approved and adopted by the BLM, Ca. DFG, and the USFS. The BLM in particular as one of the lead agencies, should include a section in the DEIS that reviews the components of those plans as they relate to the conflict between project implementation and the management goals for the deer herds that use the Casa Diablo area, one of which was to protect migratory habitats.

An Appendix to the DEIS, a Deer Study by Timothy Taylor, contains figure 3, which illustrates a "major migration trail" passing very near the project site, and a "minor migration trail" that appears to pass through the project site. On page 36 of his study he references the geothermal proposals for the Casa Diablo area among other proposals for the area and states,

> "This study has revealed that deer from the Casa Diablo herd use these areas as migration and summer habitats".

The other Deer Study, written by Thomas Kucera, states on page 22,

> "From the standpoint of deer migration and summer use, the locations of presently proposed facilities (Figure 12), are less preferable than the initially proposed site (Figure 9 in Kucera 1987).

Mr. Kucera is referring to the "Preferred Site Location" as illustrated and described in the original EA/EIR. Why was this alternative eliminated from consideration in the DEIS? This alternative represents a viable but unexamined alternative, particularly from the standpoint of deer migration and summer range needs. The result is that this omission seriously undermines the adequacy of this document, particularly from the standpoint of impacts to mule deer.

The DEIS states on page 4-66,

> "The proposed project includes requiring the below-grade installation or screening of segments of the pipeline as appropriate which would effectively mitigate impacts".

6-39a Where in the DEIS is there any quantitative value placed on the words "as appropriate"? In order for the effectiveness of this mitigation to be determined, specific proposals for the use or screening or subgrading must be given.

6-39b Is "below grade" the same as "subgrade"? If so, will there be the use of "buried" pipeline? What is not described is which sections of pipelines are to be subgrade, below grade, or buried in all of the action alternatives.

For instance, Figure 2-6 gives no indication of where or if these techniques will be used for the Alternative Site Facility Location. The mitigation listed for this impact under the Alternative Location impacts is to locate the power plant in the "preferred" location. This is a prime example of how the DEIS handles its treatment of

6-39c alternatives throughout. In this case, the mitigation should focus on the resource as affected by the alternative in question, not simply refer back to the preferred location to solve the problem. This type of treatment of alternatives is another serious deficiency of the DEIS.

The DEIS states on page 4-66,

> "Noise and human activity...may cause migratory deer to avoid the area but would not adversely affect...deer populations

This appears to be a contradictory statement. If deer must "avoid the area" then it follows that some effect must occur.

6-40 The DEIS follows that,

> "Similarly, it is unclear to what extent deer are affected and no specific result can be anticipated with respect to deer populations and noise levels".

This statement is unacceptably vague. If the extent of impacts to deer from noise is "unclear" then this lack of information mandates the preparation of a worst case scenario.

The same page draws an unrealistic analogy between the abilities of deer to jump fences. An example is cited of deer jumping fences eight feet tall to to reach "well watered vegetation". It is implied that it is reasonable to expect that deer using the PLES project site will then be able to jump fluid transmission lines. The DEIS should note that these animals may be pregnant does, at a low nutritional ebb after 6 months on a poor winter range and in the middle of a stressful migration. The DEIS should provide data to back up the contention that fluid transmission lines will not provide an obstacle to deer migrating through the project area on the way to their summer range.

6-41

Page 4-69 states that deer populations are currently stable in the region. Although population numbers may be stable, a more accurate characterization of the situation would be that the population may be on a temporary plateau while on a predominantly downward trend. Surely the DEIS is not making the claim that current developments and land uses occupying winter ranges, migration corridors, and summer ranges, have not contributed to declines in deer population numbers. If so it is in conflict with the contents of one of its appendices, "Casa Diablo Deer Study" by Taylor. This study states on page 1,

6-42

> "However, a decline of mule deer in the west has been a major concern of many state conservation agencies. A general statewide decline in California's deer herds has been occurring since the mid 1950's".

The author of the Deer Study, Final Report, 1987, Thomas Kucera, wrote a personal letter to the Mono Board of Supervisors on March 1, 1988. That letter reads,

> March 1, 1988
>
> Dear Supervisors,
>
> "I have been reading with some dismay reports in the Review -Herald regarding the apparent headlong rush to approve a complex of geothermal development in the Casa Diablo area of Mono County. Having done some of the wildlife work used in the environmental documents of several of the projects, and having done other wildlife research in the area for several years, I am somewhat familiar with the area and some of the issues.
>
> In my reports on wildlife concerns of the various projects, the conclusions and recommendations invariably included the comment that, while the specific project being considered may not by itself be of major concern regarding wildlife, the fact that several projects are being discussed in a small area requires a more comprehensive analysis of the cumulative impacts of all projects. Further, NEPA and CEQA require that such analyses be performed. Thus when faced with a suite of proposed environmental changes, it is not only wise, but required by state and federal law, to consider the suite as a whole. It is bad public policy, and counter to law, to ignore the forest for the trees.

I have tried to make the same point in personal testimony to the Board. I hope you will consider this rapid rush to industrialize part of Mono County in a larger and more comprehensive fashion, giving special importance to those qualities of the County that make it attractive and that, if managed wisely, will keep it attractive indefinitely".

Sincerely,
Thomas Kucera
2909 Regent #2
Berkeley, CA. 94704

(emphasis is author's)

Mr. Kucera is clearly advising that the cumulative impacts of all geothermal development in the Casa Diablo area must be carefully considered. He emphasizes that even though a project by itself may not be of major concern, the concurrence of a number of projects "requires a more comprehensive analysis of the cumulative impacts of all projects".

DEIS page 4-69, cumulative impacts,

"Cumulative impacts to local deer herds are potentially significant".

We believe that this acknowledgment, succinctly stated, is in many ways the focus of the issue concerning mule deer. If all project developers can correctly state that their projects, considered on its own, will not significantly impact the resource, then how is it that a cumulative impact can result? The answer is that the whole is great than the sum of its parts. When the incremental stresses to pregnant does, habitat losses, and subtle interferences to migration routes are all added up, a significant adverse effect is the result.

We acknowledge and agree with this finding in the DEIS, that the PLES will contribute to a significant cumulative impact on mule deer populations in the Casa Diablo area. Unfortunately, mitigations suggested for this impact are too general in content, and as such do not propose specific solutions to the problem. Although we endorse the concept of the mitigation listed on page 4-70, we suggest some changes in its current form.

Off site mitigation measures (such as critical habitat acquisition) should be employed proportional to the acres impacted by the project. This is not quite the same as the acres "disturbed" by a project, due to the fact that certain project facilities, while creating little actual ground disturbances (such as above ground fluid transmission pipelines) may impact deer movements over the acreage through which they cross. More importantly, acquisition of winter range will not offset adverse impacts that occur in the migration corridors. Therefore, acquisition efforts as a mitigation should occur in habitat types that are the same as those impacted.

6-43

We have yet to see any movement by the proponent in the direction of acquisition of critical mule deer habitat (such as migration corridors or winter range). Instead, the responsibility of acquisition is laid at the doorstep of conservation organizations or government agencies. (see page 4-70 DEIS) This suggestion is misguided at best, and avoids the issue.

We object to this attitude for it is the proponent whose development agenda will impact this deer resource, and therefore it is the proponent who should provide the mitigation. Acquisition of habitat with the intent of preservation, or improvements such as watering stations should be implemented by the developers.

6-43

The Taylor Deer Study also speaks to the need to consider impacts from a cumulative standpoint on page 36,

> "Therefore, in order to insure the welfare of the Casa Diablo herd it is imperative to evaluate the effects of land use projects on an individual and a cumulative basis".

Although an attempt has been made in this DEIS to evaluate the cumulative impact to wildlife in the Casa Diablo area, we believe that it has not gone the distance. As we mentioned under our discussions concerning Hydrology, it will be necessary to conduct a comprehensive analysis of all existing and reasonably foreseeable proposals that will occur in the migratory corridors of the Casa Diablo, Buttermilk, and Sherwin Grade Deer Herds. Only in this way will it be possible to accurately determine the true tolerance for deer to biological stresses that will be introduced as each of these projects is implemented.

An important point to remember is that Pacific Energy Company has corporate ties to approximately 80% of the proposed or existing geothermal development in the Long Valley area. As such, they will clearly have a significant role to play in any impacts that will accumulate as each successive project is constructed. In light of this fact, Pacific Energy Company has an obligation under NEPA and CEQA regulations to contract for an EIS to be prepared that fully assesses the scope of its actions from a cumulative standpoint. We feel that this DEIS has avoided this issue in its treatment of cumulative impacts in all resources of concern, not just wildlife.

The discussion of terrestrial wildlife could benefit from the addition of specific mitigation proposals regarding mule deer. The use of buried pipelines should be specifically identified on the site facility illustrations. Similarly, deer crossing ramps should be discussed as a mitigation measure, again, giving specific locations of where such ramps would be used. Design of fencing should be detailed.

Page 4-68, DEIS paragraph 2 implies that the impacts to deer from the alternative plant location may be greater due to the wider area of disturbance. This may be true. However, the suggested mitigation to locate the power plant at the proposed site skirts the issue. The DEIS in "rigorously exploring" this alternative should make some effort to identify ways that this action alternative could be mitigated with respect to mule deer impacts.

6-44

AQUATIC RESOURCES

6-45 Page 4-72, Mitigation (12), This is not a mitigation, only a promise to collect data or do a further study, see discussion under Water Quality and Hydrology.

6-46 Page 4-73, No action Impacts, under "Mitigation" replace with the words, "Require Mammoth Pacific I to install emergency spill containment structure as detailed in the PLES DEIS".

CULTURAL RESOURCES

6-47 Page 4-77, add the words,

> "A qualified archeologist shall be retained by the developer and be present on-site at all times during construction activities such as excavation and grading, should previously unknown objects of cultural..etc. The archeologist shall have the power to halt construction, if in his/her judgement, significant new specimens meriting further investigation are discovered".

If this is not the case, it is doubtful that construction personnel will have the knowledge or expertise to recognize such specimens if they are discovered. Page 4-79, same as above.

RECREATIONAL RESOURCES

6-48 As we pointed out in our scoping comments (pages 1, 13, 14) the DEIS should make an attempt to quantify the issue of adverse impacts to the area's recreational resource. The conflict between the possible proliferation of geothermal powerplants at Casa Diablo and recreational values of open space that the area enjoys is a source of considerable controversy among citizens and business owners in the neighboring communities. We discussed this issue at length in our scoping comments on page 22. The potential to impact the Hot Creek Gorge through impacts to the hydrothermal reservoir would be of serious consequence to the members of local communities. The DEIS should quantify how an erosion of the 95,000 RVD's enjoyed at the Hot Creek Gorge relates to the economic base of the communities (due to its "less valuable" status as a geologic interpretive site, were it to be impacted).

3-48 The brief discussion on page 4-83 of the DEIS is insufficient coverage of this topic. Visitors to the Eastern Sierra enjoy many recreational activities, not just the Hot Creek Gorge Geologic Site and Fish Hatchery.

6-49 DEIS page 4-84, the suggestion that impacts to the aquatic environment can be mitigated as a result of the proponent agreeing to "restock the affected fisheries" is short sighted, simplistic, and fails to substantially lessen the potential for impacting a wild trout stream. Please see our discussion of this topic under Water Quality and Hydrology, as well as our scoping comments for the DEIS page 19.

This DEIS is deficient in its description of the potential impact to these recreational resources, and it offers no data to indicate the substantial fiscal losses that community businesses would incur if any of these impacts were to occur. Contrast this cursory treatment with the identified Environmental Consequences to be felt in the area of Economics. This topic of "construction and taxes" Economic impacts receives substantial quantitative treatment, unlike recreational economic resources. It is yet another example of the pro-development bias of the DEIS, a bias which casts a dark shadow over the question of the legal adequacy of this document pursuant to NEPA regulations. 6-50

Once again, we must point out that the promise to do a future Bioassay study (page 4-84) to determine the effects of geothermal fluid on aquatic biota is not a mitigation. Mitigations, as we described under Water Quality and Hydrology, are actions that will eliminate or substantially lesson an adverse affect.

Page 4-84, "Impact" middle of the page, the DEIS fails to note that "sight-seeing" is a major form of recreation that occurs on the Inyo National Forest, and presumably also on that part of the forest that surrounds the project site. See our scoping comments page 13. 6-51

VISUAL RESOURCES

The extent of the visual analysis seems to be based on the assumption that viewers will be wearing blinders. The Sensitive vantage point used to generate Figure 4-1 is just that, a single point. Not only is it a single point, but it is also the lowest point along Hwy. 395 from which to view the project site. As a result, the impression given in figure 4-1 is very misleading. For instance, the overpass of Hwy. 395 at the intersection of Hwy 203 offers a much more exposed vantage point. In addition, people engaged in recreational activities on foot on the thousands of acres of surrounding forest service lands will have an unobstructed view of the project site. (see our scoping comments page 12) 6-52

The DEIS makes contradictory statements regarding the USFS VQO for the site and whether or not the PLES project will be in compliance with that VQO. On page 4-95 under Cumulative Impacts,

> "In views from Highway 395 and Route 203, these power plants and their ancillary facilities would not likely be noticeable to the casual observer".

The criteria, for the VQO of "retention" which is the VQO is to maintain the natural appearance of the area, so that surface disturbances are not noticed by the casual observer. This passage in the DEIS is saying, in an indirect way, that the retention VQO will be met. Yet the DEIS states on page 4-91 that as a result of implementation of listed mitigations, that the VQO would be met "over a period of 10 to 15 years". The implication is that, until "10 or 15 years" has passed, the VQO will not be met. So which is it, compliance or noncompliance? It appears to us that until the landscaping can grow to substantial size, a significant visual impact will result during the interim period of "10 to 15 years". 6-53

It is interesting to note that the mitigations listed on page 4-91 DEIS, are almost verbatim as those listed on page 4-46 of the original EA/EIR. The only difference is that the new set lists "Native trees would be transplanted...". How many trees, now tall, where would they be planted?, are all unanswered. The point to be made is that the original EA/EIR concludes at the end of its list of mitigations,

> "...even with mitigations the plant would be noticed by casual observers and the project would therefore be inconsistent with the VMO of "Retention". However, when fully mitigated the plant could meet "Partial Retention" objectives".

The conclusions of these two documents, based on fundamentally the same data, are completely opposite. Although transplanting of larger tress may increase the effectiveness of vegetative screening, such techniques have only been attempted recently. It remains to be seen whether these trees have a high rate of survival after undergoing a winter season. Even though there exists a "Landscape and Revegetation Plan", Appendix B for this DEIS, this appendix has not resulted in the creation of any new mitigations for visual impacts. (compare lists on pages 4-91 DEIS, and 4-45 EA/EIR) In light of this, how can the two documents reach such different conclusions while being based on the same evidence?

It should be noted here that in denying the Mammoth Pacific unit II Geothermal project, the Mono County Board of Supervisors were considering a basically identical project, proposed to be situated behind this PLES project, which had access to all of the same visual mitigations as defined in this DEIS. Even in light of all the ideas and visual mitigations that the proponent could develop, the Supervisors, in denial, adopted the following findings, 88-118,

> "Geothermal development at the proposed location of this project will create unacceptable visual impacts, which may adversely affect recreation and tourism and which will change the natural character of the environment in the area of the project. While the Mono County General Plan may encourage environmentally sound geothermal development, this board is not required to and does not accede to this request to permit geothermal operations in the highly visible location near U.S. Highway 395 and the intersection of Hot Springs road and the extension of State Route 203 where project construction and operation would occur".

Also adopted was finding 88-121,

> "The Draft EIR described the cumulative visual effect of the project in combination with the existing Mammoth Pacific I project and the proposed PLES I as significant. The response to comments in the final EIR stated: "The impact would be significant, even after mitigation". This Board agrees and cannot therefore approve the project".

In considering whether or not the proposed PLES project will result in significant visual impacts, the Lead Agencies should weigh and consider the decisions made by the Board of Supervisors.

We would now like to comment on the list of so-called "mitigations" for visual impacts on page 4-91 DEIS. For ease of reference, we will refer to them as mitigations 1 through 8 as listed in consecutive order on the page.

6-54 1) Avoiding mature trees "whenever possible" is a vague and unclear statement. What is the criteria to be applied when such judgements are being made?

6-55 2) "Partial or complete" revegetation of disturbed area "as soon as practical" is another example of the same situation. Which areas will be ignored if "partial" revegetation is implemented? What are the guidelines that will identify what is "practical" as far as timing is concerned? Unless the DEIS provides some specifics on these questions, such words should be eliminated from the mitigation

6-56 4) Will exterior surfaces be visually unobtrusive from the south and west or will they not? The "extent compatible" should be identified in the DEIS.

6-57 5) How much exterior lighting will be necessary? Scattered ambient light levels emanating from the project site should be quantified.

6-58 7) Is there any specific proposal for the size, numbers or densities per area of land regarding the idea of planting trees for screening? These data should be present in the DEIS.

6-59 8) This statement gives the impression that the locations of pipelines is somewhat flexible. If pipelines are to be placed to take advantage of natural vegetation or topography, how will that placement correspond with with the pipeline locations as illustrated currently in the DEIS? Furthermore, as is the case in most of the other mitigations on this page, what is meant by the word "possible"?

In summary, the general and vague nature of the mitigations listed for visual impacts does not allow decision makers to accurately assess the effectiveness of those mitigations. These mitigation suggestions are open-ended and noncommittal in terms of how, where, when, or how much is going to be done to substantially lesson the impact. As written, there is insufficient data and incomplete information (NEPA 1502.22) available to allow an informed decision to be made regarding the significance of visual impacts. We therefore find the conclusion of the DEIS that visual impacts can be mitigated to a level of insignificance to be arbitrary and capricious.

LAND USE PLANNING

There are two land use planning efforts underway in Mono County that the DEIS does not mention, and that would be in conflict with the proposed land use at Casa Diablo. These involve efforts to establish a National Recreation Area, and the Mammoth Trout Park. We brought forward this issue on page 36 of our scoping comments, yet as is the case with many of the concerns raised in that letter, no attention has been paid to this issue in the DEIS.

6-60 As we have stated in our scoping comments, the component of National Forest Lands that is in riparian habitat is less than 4% of all available land. This habitat is vitally important to the large recreational use that the forest enjoys. The Mammoth Trout Park is an emerging concept that puts a recreational focus on the fisheries resources (which of course depend on the riparian habitats) of the Mammoth Lakes Area, with Hot Creek and Mammoth Creeks as its focal point.

We believe that if geothermal development is allowed to expand in the Casa Diablo area, irreversible degradation of the ecosystems of these
6-60 creeks will result. The DEIS has offered no feasible mitigations for rehabilitating that ecosystem in the event that its "fail-safe" spill retention system doesn't work. We perceive this as a Land Use and Planning conflict, and feel that it merits discussion in the DEIS.

The creation of a National Recreation Area in the Mono/Inyo county area is a concept that is gaining attention and momentum among area planners, and government agencies, both town, county and federal. As we have stated, the resources values that provide the basis for our recreational use are in direct conflict with this type of land use, especially when it occurs in such sensitive view
6-61 corridors, adjacent to critical deer habitats, and in the immediate drainage of one of the premiere trout streams in California. Management goals for resources in a National Recreation Area would give emphasis to preservation of existing levels of amenities, through the use of strict adherence to such things as Visual Management Objectives and Deer Herd Management Plans.

These are two examples of land uses that are currently being planned which will encompass the Casa Diablo area, which may have potential conflicts with the proposed PLES Geothermal project, and which should be discussed in the DEIS.

ECONOMICS

Page 4-101, mitigation (10), In our comments regarding water quality and hydrology, we pointed out that such a mitigation scheme would take on the complexity of a completely new project proposal. Depending on the makeup of such a proposal, which as presented is undeterminable, numerous environmental impacts could surface as a result of attempted implementation of this mitigation. The language in this mitigation defers until later the establishment of this critical data.

There is insufficient detail to evaluate the effectiveness of this mitigation, and it is therefore inappropriate for a permit to be
6-62 granted in advance of further delineation of this plan. Ability to offset impacts at the hatchery depends on the success of this plan, it should be available for readers to study as a part of the DEIS. The prediction of the DEIS that this mitigation would allow timely implementation of effective measures is not based on any data contained in either the DEIS or its Appendices, and as such, is purely speculative.

We do not believe that it can be demonstrated that an environmentally acceptable mitigation for this potential impact can be developed, and we call upon the DEIS to prove us wrong. In
6-63 consideration of the lack of data and cursory mitigation proposed on page 4-101 of the DEIS, it should be stated that the economic resources of the Hot Creek Gorge and Fish Hatchery are destined to remain at risk, should a hydrothermal impact occur.

The Economics section of the DEIS should mention the administrative and legal costs that permitting agencies may incur as a result of reasonably anticipated challenges, appeals, or litigation arising from disputes between agencies or organizations and project proponents as a result of disagreements over interpretation of what constitutes a significant impact to the environment as caused by PLES I. Clearly such entities as the BLM, GBUAPCD and Mono County must have incurred such costs as a result of such actions that have already occurred. 6-64

COMMUNITY SERVICES

Page 4-106, The DEIS appears to suggest that risks associated with the long response time to the site can be lessened through the implementation of a "Fire Protection and Prevention Plan". Although a plan will increase awareness of the hazards, it is not a substitute for readily available equipment and trucks.

A mitigation for the problem of the approximately 15 minute response time would be for the PLES facility to maintain firefighting engines and equipment on site, rather than relying on such entities as The Long Valley Fire Protection District or the Town of Mammoth Lakes to respond. Any fire that spread off-site on to adjacent forest lands presents a threat, and potential impact, to the resources values associated with those lands as they exist today in their unburned condition. Some of those resource values include wildlife habitat, watershed qualities, scenic quality, timber resource, and sensitive plant communities. 6-65

As the number of geothermal projects could be projected to increase at Casa Diablo, the risk for fire is also concentrated. We suggest that this mitigation measure be added to the DEIS.

GEOTHERMAL RESOURCE LEASE

Page 4-116, It is suggested here that the no action alternative would result in a Breach of Contract between the lessee and the Federal Government. More accurately stated, this contract requires utilization of the Geothermal Lease in an manner which avoids environmental impact. The adverse environmental impacts resulting from action alternatives associated with PLES I would prohibit the fulfilling of such a contract. 6-66

This concludes our comments on the PLES DEIS.

ELLEN HARDEBECK
CONTROL OFFICER

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

157 SHORT ST., SUITE #6 - BISHOP, CA 93514
(619) 872-8211

RECEIVED
BISHOP RESOURCE AREA
NOV 18 '88

November 7, 1988

Mr. Jim Morrison
Area Manager
B.L.M.
787 N. Main Street, Suite P
Bishop, CA 93514

Dear Mr. Morrison:

Enclosed are copies of all comments received by Great Basin Unified Air Pollution Control District on the Draft EIS/Supplemental EIR on the PLES-I Geothermal Project. I also have attached a transcript of the public hearing held in Mammoth Lakes on October 21, 1988.

I have sent a copy of all these comments and the transcript to Sandra Guldman of ESA.

Sincerely,

Ellen Hardebeck

Ellen Hardebeck
APCO

EH/dl

Enclosures

cc: Sandra Guldman

PUBLIC HEARING ON PLES 1 GEOTHERMAL PROJECT
DRAFT EIR SUPPLEMENT

October 21, 1988 - Mammoth Lakes, CA

The welcoming remarks and introductions of the Great Basin Unified APCD staff were given by Debra Lawhon before the tape recording was started. In addition she mentioned that the hearing was solely to take testimony, either oral or written, on the Draft EIR Supplement. Since this second hearing concerned only that document, there would be no presentation by the project proponents, and no information given on the project itself.

Debra Lawhon: What I'd like to have you do is when you come up to speak, or if you are speaking by the overhead projector, try to speak up and first give your name so that when later on we transcribe these recordings we'll be able to identify who's speaking. So if we can give the person's name when we first get started, if later on you happen to say something later on in the meetings, please give your name a second time -- if you speak a second time. That's about all I have to say so the first person to speak is Timothy Durbin, his agency is, he's actually working with California Department of Fish & Game and the S.S. Papadopulus and Associates.

Timothy Durbin: I am Timothy Durbin and my firm has been retained by Cal Fish & Game to do a couple of things. First of all to help them prepare comments on the EIR and to do independent analyses of the impacts of the projects on the geothermal resources of the area. As a bit of introduction and to make a little bit of statement regarding my credentials to talk on this subject; I've been with this Papadopulus and Associates for about four years. Prior to that I was head of the U.S. Geological Survey, Water Resources Activities in California and that position involved directing the work in 14 offices throughout California. One of the projects that was being conducted under my direction at that time was the -- there would be work that is on going still by the USGS in the Mammoth Lakes area; the work that Chris Farrar and Stewart Roistosser [spelling?] and others have been doing at time was being done under my direction. Prior to holding the position as District Chief for the USGS for California, I had a similar position in the state of Nevada. There, there was a very large geothermal program that was being conducted in Nevada by the USGS, and that program consisted of two parts. One part was a research part in which we were developing and evaluating various techniques for the evaluation of geothermal resources, so we were trying to develop sort of the basic tools that hydrologists use to examine and to evaluate geothermal systems. The other part of the work was to do specific evaluations of various KGRA's in Nevada and that work was done principally for the US Bureau of Land Management as part of their process of setting value on lands that potentially would be leased to developers. Our firm has extensive experience in geothermal matters, in ground water; myself and other principals of the firm have developed computer programs for modeling ground water systems that are used throughout the world by hydrologists and we are currently doing work for the U.S. Environmental Protection Agency for some very specific model development things. So that's a little background of who I am, what I am bringing to some of the remarks that I'm going to make.

Timothy Durbin (CONTINUED):

First of all, I think I'm going to say up front that there -- what I'm going to say at the end and in where I'm going to get to at the end of my comments is the basic conclusion that the planned geothermal development including the PLES but also the other projects that are proposed for the Long Valley area will cause a significant adverse environmental impact. The second conclusion that I'm going to come to is that the EIR as it now stands is totally inadequate with regard to attempting to make any kind of assessment of what the
7-1 impacts of this project and other projects will have on the geothermal system and the environmental element such as the hot springs and hot creek that are dependent upon this geothermal system.

Now, to start there are some basic concepts that are going to apply to my comments and I want to run through those and the slide that I have up states what those are. And the first one is the notion of the "Water Budget". And a water budget is just simply an accounting much like you might do an accounting of your checkbook or of your bank account. It says that the "Inflow" minus the "outflow" equals the "storage change". Now if you put that in terms of your bank account if you have more money being deposited on a regular basis into your bank account than you are withdrawing then the amount of money in your bank account goes up. Likewise if you withdraw more than you put in, the amount of money in your account goes down. And the same thing applies to water in the ground water system -- if you put in more water than you are taking out the water levels rise and if take out more than you put in, water levels decline. This same concept applies to heat. That you can, if you put in more heat than you take out the stored heat within the geothermal system goes up and that's manifested in increased temperatures; likewise, if you take out more heat than is being put in then the stored heat goes down and the temperatures within the geothermal system on the average go down.

Now, let's consider the pre-development condition. Prior to any development in the geothermal system, you basically have a system in which there's a large bank account-- we might talk if we are going to talk of in terms of dollars, many thousands of dollars -- ten thousand dollars -- and we have heat coming into the geothermal system and we have an equal amount of heat going out. So we have a system in which the bank account stays constant because as we put in heat, heat is coming out. Now the heat that comes in is coming from the deep magma sources that basically occur in the center of the Long Valley Caldera at a very great depth. And that's where the heat is coming from. That heat that is coming in then, all the heat that comes in ultimately gets discharged. And that heat is getting discharged in basically two ways. One we have what is called convective heat discharge from the system and this is the heat that is being carried out of the geothermal system by the hot water that is discharging from the various springs and is accumulating in Hot Creek and discharging out of the valley. So that's one source of heat discharge. The other source of heat discharge is conductive heat flow and this is heat flow that results from simply the movement of heat through the soils, and the heat from the hot ground water that is in the subsurface. Heat goes up through the soils above the ground water table and finally comes to the land surface and is disbursed into the atmosphere. The place in the valley where this

occurs is in the area down by Crowley Lake in the meadow areas that are on the west side of the lake -- there is a large area in which there is a very significant conductive heat flow.

Now, Post-Development Conditions. The basic concept of the heat budget applies to the understanding of the situation. Under the Post-Development condition we start to put a withdrawal of heat on the geothermal system so we are taking heat out. Now, the amount of heat that was coming in naturally before is basically the same. And we have to go back to sort of the bank account thing under Pre-development Conditions maybe we have a hundred dollars coming in and a hundred dollars coming out and when we get to the Development situation we turn to a situation where we are taking out on the order of a thousand dollars, to put it in those sorts of terms, a thousand dollars out of our account and, however, through the re-injection wells some of that is put back so that the developments are all taking heat out of the ground water system converting part of into electricity and putting the remainder back into the geothermal system. That amount that goes back in might in our bank account terms, might represent a hundred dollars and so there is a net "Out" of nine hundred dollars so that with development, what it does is start to deplete the heat that is stored in the geothermal system and if we use; I think at one time I made a statement that maybe we could call it $10,000 was stored, we start to at $900 a year or something like that, start to take out that much net extraction of heat and what happens is that the heat stored in the system goes down and temperatures go down. That description follows from, again, basic consideration of the heat budget which in turn is based or just a way of stating the law of conservation of energy and an important aspect is that that conceptual basis depends, does no way depend upon the any sort of conceptual model that you have about what the geolcgy is like out there.

Okay, so what happens? Start to remove heat from the geothermal system and this can be thought of directly analogous to the condition of a mine, say an open pit mine in which we are excavating mineral ore. And we start to take material out and a hole is left behind. And when you take heat out of a geothermal system you leave a thermal hole in the geothermal system and which again is very much equivalent to the hole that is left behind in open pit mining. Now, from some just some very basic calculations and with knowledge of how much heat all the projects taken together are going to extract from the geothermal system that it's a fairly straight forward thing to come up with a value that these pits that will be created in the system are gonna have a volume equal to something of the order of a cubic mile -- which is a very large volume. If we assume that perhaps the actual depth of these pits is maybe only 500 feet or so the area that would be affected would have a surface area of 7 square miles. Only from consideration of how much, well, the only way you can get heat out of the geothermal system is to reduce the temperature of a certain volume of a system. The developers, the project proponents, have stated that they have certain plans to extract a certain amount of heat from the geothermal system. This is the volume of water, or the volume of the geothermal system that has to be cooled in this

Timothy Durbin (CONTINUED):

particular estimate it was considered this volume was going to be cooled an average of 100 degrees C everywhere. This is the volume that has to be cooled in order to produce the amount of energy. Now, one of the things that in the EIR that is the subject of this meeting and in other EIR's that have been prepared on these projects, there are calculations that have been done that make some statement about the volume or the area that will be affected by the injection wells. Now, a question now is -- well, first of all those volumes are significantly smaller than these volumes that are stated here. And the question is why are they different? To answer that you have to go back to sort of the, again our bank account thing. And I stated earlier that the development of geothermal system involved taking money out of the bank account and putting some back in. And that on the order of $900 is being taken out and a $100 is being put back in. The calculations that are done within the EIR deal only with the re-injection part of it. And so they ignore, totally ignore this other $900 that is being taken out. In no way look at the heat that's been extracted, they only look at some of the issues regarding what is put back. And the situation goes further in that while they've done some calculations in the EIR those calculations are really not relevant to the overall issue of how much of the geothermal system is going to be affected by development. It's almost as if they have answered a totally different question. The calculations that they do for their, what they call the bulk model, are totally unrelated to how much of the volume of the system is going to be affected. Again it's like if someone asked, or if I were to ask you what is the county seat of Mono County and you answered 24. Well, 24 is possibly the answer to what is the sum of 12 and 12. But it's unrelated to the issue of what is the county seat of Mono County. And in the same way the calculations, while technically correct and they answer a question -- it is not the question of what the impact on the system will be.

What happens to these thermal pits? Well one of the things that will happen to the thermal pits is that thermal pits of various sizes will be, will form around the various injection and production wells for the various projects, and over time these spread out and in some cases the various pits will merge together. But after the 30 years of production just one cubic mile of system will be affected. Now those pits will not just stay at the, in the areas of injection and production wells; what will happen they will start to migrate within the regional ground water system. And the direction of ground water flow in that system is well documented and that direction is from the west to the east. So that these pits as they are formed will move towards the east and towards the vicinity of the Hot Creek and the springs that feed Hot Creek. Now the rate of migration is very slow and it may take on the order of hundreds of years before these pits reach the area -- but eventually will and that's a foregone conclusion and there's no way of avoiding the fact that eventually these pits will migrate to the areas of thermal discharge for the geothermal system and in the areas where springs occur those pits will cause a period during which temperatures of the springs are suppressed and in the areas where the heat is being conducted by, to the land surface and then into the atmosphere the rate of "heat flow" at the land surface will be reduced. The Hot Creek is the first

Timothy Durbin (CONTINUED):

thing that is in the path of these migrating pits and so that the first and most pronounced affect will be felt on the springs that are discharging into Hot Creek.

What these several pits might be thought of as, can be thought of conceptually in a lot of different ways. One way is to think of the, well first of all the thermal pits simply mean there is less heat in the system. And the thermal pits might be, could be thought of in terms of as a pollutant and there's a certain mass of pollutant that the project will introduce into the geothermal system and that pollutant will stay in the system until it sort of washed out over perhaps centuries through the spring discharges and through the conductive heat flow. And during the period that the pollutant is being discharged you might think that's the period of time in which the springs will "be contaminated". They will be contaminated in the sense that they will have cooler temperatures in them. And again from a conceptual standpoint the analogy, is I think, between a pollutant and the reduced temperatures are quite appropriate in that it conveys the sense that the reduced temperatures are an adverse affect that will occur on the geothermal system.

Earlier, or at the very beginning of my presentation I said that the EIR/EIS was inadequate in the way that it tried to analyze things. I stated that the bulk mode calculations answer a question that isn't really a relevant question to the problem at hand. And so then what is needed to properly understand the impacts of the [development] on the system? And the only real way this can be accomplished is to put together a model that represents all of the essential processes that are going on in the geothermal system. And these processes are those that cause the formation of the thermal pits. They are the processes that affect what happens around the production wells both hydraulically (sic.) and thermally and the processes that affect things that are happening around the injection wells and also the processes that affect the migration of the pits through the geothermal system. The techniques for doing this are quite well developed and it is just a matter of doing it and in fact as an independent exercise that I am doing this kind of modeling for California Department of Fish & Game. Without it, in this kind of work, being the basis of the EIR/EIS there really is no way of being very explicit about the timing in which impacts will occur. Now, from the earlier considerations of the heat budget we know that the impacts will occur and we know that the total mass, if you will, of the impacts -- we know what those will be. What we don't know, but can answer with a complete model of the geothermal system is how that total mass of heat deficit or pollutant, whatever term you want to apply it; how the impacts of that are distributed among the spring discharges in the, and the conducted heat flows. We know what the sum of the impacts on those two are but we don't know how much of the impact goes to the springs and how much goes to the conducted heat flow. My belief at this time is that if this modeling is done that it will be discovered that there will be that most of the impact will go to the spring discharges.

7-2

The modeling that has been done in the EIR/EIS is completely

Timothy Durbin (CONTINUED):

inadequate and is no basis on which to make any decisions regarding what the impacts of the development will be on the geothermal system and the environmental elements that depend on that system.

Some conclusions regarding impacts:

1) These thermal pits are going to be created and we can state very positively how large those pits will be. We can state that the pits will eventually migrate to the discharge areas. There has been a lo of controversy generated around some issues of what is the proper geo-hydrologic-hydrologic conceptual model to apply this system. The first two conclusions are independent of what conceptual model you apply to this system. You may recall that the basic debate is over whether we have basically we have a system in which we have isolated up-welling of heat or we have lateral flow of heat. I think that, well, first of all the conclusions are independent. But I think tha the truth of the matter is that the system is mostly a lateral flow system to where we have local areas where water is moving upward, the hot water is moving upward into the shallower system.

2) Another conclusion is that the temperature and heat flux in the areas of thermal discharge will be reduced and they will be reduced in a very significant way. I have done some tentative calculations that suggest that Hot Creek will eventually experience a period lasting somewhat of a hundred years, in which on the average over that period, temperatures within Hot Creek will be reduced perhaps a much as 25 degrees C.

7-3 In the EIR/EIS there was one paragraph which asked the basic question of why would anybody invest in this, in these various projects if things are as bad as they appear to be. And that's sort of a question that I have been pondering because I can't understand how it is that the project proponents cannot be aware of the basic facts of life and that with some very simple calculations using simply a heat budget you have to come to the conclusion that this geothermal system cannot support all the existing and proposed projects. Environmental constraints aside, I thing that realistically the system can support the existing plant that is out there plus another one of perhaps the same size. Recently I happene to run across somebody whose company at one time in the past was considering investing in some of the projects that are proposed for this area. And I mentioned to this person, Mike Lee, that the area was -- if all the projects were developed -- that it would be a gross over-development; perhaps in the order of a factor of 3 to 5 times as much power than the system can really support. And this person said their company basically came to the same conclusion and decided to stay completely away from what was going on here. The only thing that I can figure out that there is some way to make money on failed projects, or for projects that only last for 5 or 10 years. There's no way that this system is going to support on the order of 50 MW of power production for 30 years. These projects are going to fail long before that happens. And that ends my comments. Now I have xerox copies of the various slides that -- I should have them already, so thank you.

Debra Lawhon: Thank you, you timed that pretty well, 29 minutes and 50 seconds.

I notice we've had 2 or 3 people walk in after we had started and if I could just request you to come up and sign in, then we will know who attended the hearing.

Unidentified man: Can we sign in after the meeting?

Debra Lawhon: That's fine. The other thing then is -- if any of you want to speak then you can let me know so that I give you a time and get your name.

[None of the late arrivals indicated an interest in giving testimony.]

The next person in the group here is Tom Heller who's with the Forest Service in Mammoth.

Tom Heller: My name is Tom Heller, I am with the Forest Service here in Mammoth Lakes. And basically just a couple of concerns, maybe things that were just omitted or things that maybe could be included in the draft document. In a couple of places there is a list of different kinds of activities that occur in the Mammoth area on, both on the draft in the summary as well as in Part 3 page 53. I'd like to see the addition of the word "sight-seeing" included in the list of activities that occur. **7-4**

In Part 2, page 49 there's talk about the recreation resource; it discusses mitigating measures for lots of geothermal features at Hot Creek -- in the Hot Creek area and one of the things that may need to be addressed, we feel would be the, if the plant does dry up the geothermal site that is down there, but the plant does prove to be profitable we would like to see some kind of a mechanism by which the plant's responsible for developing an alternate geological interpretive area as well as contribute to the removal of facilities that are currently down there. **7-5**

The third portion of the document, page 53, there's talk about the fish hatchery existing at the location because of geothermally heated springs used in their rearing ponds and I guess the comment would be that maybe there needs to be a little bit more discussion about the fact that the fish hatchery is solely there because of the geothermal quality of the water, and should that change what kind of mitigation measures are planned to satisfy the State Fish and Game and to maintain a viable fish hatchery? **7-6**

Part 3, page 54, there's a discussion on Hot Creek Gorge and it's felt that that should include that it's a major attraction and that the attraction is that the people enjoy visiting or viewing the geothermal spring as well as soaking in the hot creek. **7-7**

Part 4, page 83, under Recreation Resources - The Impacts, there's a loss of a geothermal hot springs or the loss of the geothermal hot springs in the gorge would result in the loss of a unique interpretive site and the loss of this experience and that's **7-8**

Tom Heller (CONTINUED):

7-8 something that's not really listed on the [document] or the effects of the impact. The loss of the feature would reduce the administrative work as far as the Forest Service is concerned managing the site, but as I mentioned before we would have to move the facilities, we would have to rehab the site and we'd like to see it mentioned in that area that the company would be responsible or would cooperate with the development of an alternate site as well as removal of the existing facilities.

7-9 Appendix B, under Visual Resources Part 4, page 91, there is nothing mentioned in that Appendix as far as a planting plan. I would like to see something mentioned as far as what kind of species, what sort of spacing, relationship to facilities as well as irrigation system -- what would be proposed. There's nothing in there. I didn't notice anything on lighting plans, what kind of lighting. What would be expected to be seen during night time hours at the plant in all of the different locations that are proposed? If there's a poor rate of survival as far as plants are concerned, what kind of mitigation will be involved in trying to make sure there's successful planting? And there's a discussion on the fact that there's a relatively young fault in the area, but there's really nothing. It mentions that there needs to be some kind of an evaluation made, but there's no time table involved in discussing how active that fault is. And this is in the area of the proposed preferred alternative.

7-10 And lastly, in order to avoid the artesian water fumaroles, ground water could be pumped. It's mentioned in Part 4 on page 14. What effect that will that have on the vegetation that remains in the local area if you draw down, possibly draw down the ground water table, what would happen to the remaining plants that are there? That's all I've got.

Debra Lawhon: Thank you. Okay, our next speaker will be Curtis Milliron, California Department of Fish & Game.

Curtis Milliron: Well, the Department has been accused recently of unwarranted opposition to geothermal in general -- the Long Valley KGRA. Why are we so opposed to such benign projects that do so much good? And, we feel the projects are not benign, obviously, from the comments of Tim Durbin, and there's good reason to feel that way. There's a lot at stake, the Long Valley. My Supervisor, Phil Pister, uses an analogy or makes the comment quite frequently that this is a real important area here and we have more visitors to Inyo National Forest than to Yellowstone, Glacier and Grand Teton put together on an annual basis. That's pretty significant and so we better be careful how we treat this area that's only going to be more significant as the years go by.

We've got the hatchery, probably the most productive and important hatchery in the State of California, is right here as Hot Creek Hatchery has a product of over 20 million dollars annually. That's in trout eggs that are supplied to other state facilities, other states. But mostly in fry for all the back country and a lot of sub-catchable and catchable trout. Supports Crowley Lake and that's a

Curtis Milliron (CONTINUED):

heck of a resource to lose.

The Department has already made the comment in previous public meetings that the county and people that make the decisions around here decide that geothermal is a lot more important than the fish hatchery and we're going to re-evaluate our priorities as well. That's not a threat, that's just simply a statement that says "hey you guys, now what's really important to you? Do we need a little bit more energy or do we need the fish hatchery?"

Now why is the fish hatchery really in jeopardy? Now it seems like we're only talking a few degrees here and there and so forth, but it's more than that. That hatchery is very complex and it's been operating for 50 years now and it's set up right now to take the best advantage possible of the existing situation -- the existing spring temperatures that are provided. And we use them as they come from the ground, there's nothing changed. So, the coolest water available on the hatchery is used right now for the Hot Creek Stream brood stock and other brood stock fish. It's critical that these brood stock fish are kept at a temperature below 56 degrees F. And that is a critical temperature, it's stated in Federal and State Trout Culture Documents. And what happens when you go above that temperature is that the sperm in the egg viability drops off very quickly and this is not just something that happens to be conveniently there as -- we're right there, we're at that temperature, and we can experience a problem with really just one degree change. The Hot Creek strain that utilizes -- that brood stock that utilize that lowest water temperature spring source are a unique strain. They have been developed at Hot Creek, they have been genetically altered for the last 30 years to take advantage of a -- to alter the spawning times of the fish so that when they are growing they develop -- they come off, the planted trout are ready to plant at a different time of year when the other trout come off so that we have a more complete planting schedule which is complete throughout the year so we don't have major gaps. We just don't have fish to provide for all the recreational demand in the area.

7-11

There has been some mention in this document that these temperatures, or the temperatures at these springs is quite variable and that was based on hatchery information, data provided to the people who wrote the document by the hatchery manager. But that data is really not very good data. That data was taken over the past 10 or 15 years by many different hatchery personnel with many different types of thermometers in many different areas within each spring source. There was no effort, and there was no need, to be consistently accurate on how that temperature was taken. It wasn't necessary, it was just "let's just go see how things are going -- what are we going to do here, what are we going to do there?" And that's how the hatchery is operated. But now that there's an issue there has been a greater effort to determine how accurate or how consistent, how variable those temperatures are at the various spring sources in the hatchery. And what we're finding out is they are very consistent. They don't vary much at all. And so this is something that is not reflected in the document. Instead the argument is made there that

7-11 the temperatures vary considerably, therefore, how could there be an impact of 1 or 2 degrees? How could an impact of 1 or 2 degrees make a difference? Well, these systems, these springs don't vary that much. They vary something less than 1 degree. So it could make a difference and it would make a difference.

Of course, right below the hatchery is Hot Creek, it's a -- I don't think I need to speak too much on that -- it's a well known blue ribbon trout stream. It's one of the best in the country. It's not very long, it's only a couple of miles long of really primo trout fishing areas. As Tim explained there could be an impact of some 25 degrees C. Now that's a real preliminary, cursory calculation and it's subject to change. As Tim also mentioned he's also in the process of doing a more thorough evaluation of this resource out here so we should be able to narrow that down a little better. But what does that mean to Hot Creek? If we lower the temperature, we've got another stream. We've got a lot of streams, there's not very many Hot Creeks. We're not going to replace Hot Creek easily. We can replace other streams, there are plenty of them. So we've just now taken a blue ribbon trout stream and converted it to a Sierra stream and that's not acceptable.

There's, of course, the Gorge and as mentioned why do people go to the Gorge? And we're talking about 95,000 visitor-use days just to go to the Gorge. And that's to go sit and soak in warm water in a beautiful area and to see a Yellowstone-like environment. That's not easily replaced. And it's certainly not a replacement, or not a

7-12 viable mitigation to go rip out what's already there and put a bunch of pipes in and let it bubble up and so we've got something that steams. That is not a viable mitigation. I'm sure that 95,000 people or most of them would agree with that. So if we lose a major thermal element, if we lower the temperature of that spring source that supplies that neat geothermal interpretative area, we've lost a major component of tourism to this county. That's got to be a lot more impact than what has been addressed.

There's also another issue that has been very much -- let me go back just a minute. As far as this document, it's very inadequate in addressing this thermal impact to the Hot Creek Gorge Area. It mentioned something about, well, if there's a change in pressure, which we don't think will occur, maybe it won't, then we'll put an injection well upstream and we'll boost the pressure. But they don't talk about a loss of temperature to this system -- and yet that is certainly going to happen as I stated earlier. And I don't see how you can, even if you tried to use the same idea -- how could you take water from upstream and put it downstream? Well, you're still taking water that's already been affected.

And finally, another major area of impact -- of course there's a terrestrial wildlife impact as well and Ron Thomas is here if he wants to speak on it, he's certainly more qualified to speak on that subject. But the final area I want to talk on is the thermal springs. For example, the Casa Diablo Geyser. I don't know if everyone knows this, but there used to be a geyser and it used to

Curtis Milliron (CONTINUED):

flow, somewhat variable flows, but it used to geyser at times and it had a flow and it's located right next to the existing power plant. Well it's not variable any more, it doesn't flow at all. There's nothing there. So the plants, the animals, and the habitat types that were dependent upon that geyser, that system, that microhabitat, are gone. Now we don't know if there was anything really unique there or not. We don't know if there were uniquely adapted invertebrates, algae, things that most of us consider as insignificant. But we don't know how significant they are, and we'll never know because they're not there any more. So that's a potential extinction that we don't even know if it happened or not. And that's the kind of thing we can expect with more development -- that Michael Sorrey pointed this out very strongly that there are many examples of geothermal fields where impacts to local thermal springs occur, there no examples where they don't occur. And in fact, on this system there is an example it has occurred. We've lost the Casa Diablo Geyser flow. It hasn't flowed. There has been no discharge in [the] spring source there for, since April of 1987, I think is the date. But the point there is that we've lost something we don't even know what it was -- we stand to lose a lot more of that. The Department has written comments and there are certainly a lot more points that we brought up in those written comments and those will be available sooner or later. I think that's the final point I'd like to make is that some people have questioned us already why is the Department of Fish & Game hiring a consultant. We've got the BLM and Forest Service -- they've hired consultants. The proponents have hired consultants, in fact it's one consultant. Everybody is using one consultant -- it's the same consultant, it's BGI. Personally, I don't know how you feel but if I was feeling pretty well but went for an annual check up to my doctor and the doctor says "you're in pretty good shape, but you know you've got an appendix in there and you've got some tonsils and maybe a little extra intestine. I think we'll go ahead and remove that but you probably won't feel too much." I would get a second opinion and that's what we're doing. We feel that we have something to lose here, we don't have the expertise to really analyze the potential impacts due to exploitation of this geothermal resource so we went out and we hired the Papadopulus consultant. That's all I have to say.

Debra Lawhon: Thank you. Okay, the next person who's asked to speak is Carla Neasel, she's speaking as an individual.

Carla Neasel: My name is Carla Neasel and I'm not affiliated with any organization. I just want to address a couple of ways in which I feel like this document fails to fulfill NEPA requirements as well as ignores some crucial qualities of this area.

7-13 The three alternatives in addition to the new action one are either too similar or too poorly developed to fulfill NEPA requirements of full exploration of all alternatives. For example the alternative of moving the power plant to a less visible area, the document states that piping the water from the wells to the plant would result in significant heat loss through the pipe walls and therefore would necessitate an increase in the amount of water pumped from the supply

Carla Neasel (CONTINUED):

7-13 which would then increase the impact on the groundwater resource. But no consideration is given to mitigation of that problem. For instance, insulating the pipes.

7-14 The document also states that by moving the power plant to a more forested area to reduce visual impacts, wildlife in those areas would be adversely impacted. But again the report fails to develop ways to offset those impacts such as burying pipes or otherwise allowing for wildlife movement in those areas. Another alternative, building a

7-15 smaller power plant, the document states that the environmental impacts would basically be the same, therefore it's not truly an alternative. Also the capacity of the smaller power plant would be about 7 MW which is a violation of the contract -- I believe the permittee holds for about a 10 MW station.

7-16 Finally the preferred alternative does provide for monitoring of surface water temperatures to determine if the extraction of geothermal groundwater is lowering the temperatures of the hot springs, such as Hot Creek, but it does not provide for mitigation should lowering of temperatures occur. The proposed mitigation of re-injecting semi-cool water back into the ground is not a proven method either of replenishing the supply or of maintaining surface water temperatures at their natural levels.

NEPA also requires that unless it is too costly all relevant information should be included in the EIS, but the following are some examples of pertinent information which is not included in the

7-17 document. It does not contain the findings of preliminary studies on significant earthquake faults in the proposed power plant area and further studies should be done. It does not include any sort of bio

7-18 assay to determine the effects of geothermal fluids flowing back on fish, other wildlife and plants in the area. And finally the other options which were proposed in earlier public meetings such as

7-19 utilizing previously existing solar energy plants or perhaps building another solar energy plant in a different and less sensitive area were not explored as alternatives.

Due to the many deficiencies of this document it's very possible that concerned members of public resource agencies or conservation organizations may feel compelled to seek relief through the appeals process. It would probably be a better use of time and resources to withdraw this faulty EIS and prepare a revised draft. Such a thoroughly revised and prepared EIS would certainly find that the Long Valley Caldera area is a highly inappropriate location for geothermal development. Given logistical problems, fish, wildlife and botanical considerations as well as the presence of unique recreational and wildland values.

I just want to speak as to why people live in this area. People come to live here because of the uninterrupted vistas and the natural wonders as well as the tremendous recreational possibilities. Industrializing the area destroys the very qualities so many thousands of people come here to seek either as permanent residents or as revenue-bringing visitors. Alternative sources of energy are

Carla Neasel (CONTINUED):

needed but not at the expense of wildlands and esthetic qualities that we all need to survive.

Debra Lawhon: Thank you. Our last speaker is Frank Stewart of the Sierra Club.

Frank Stewart: This should be fairly close to what I am going to say. [He then handed-in written testimony.] My name is Frank Stewart and I'm here today on behalf of the Toiyabe Chapter of the Sierra Club, as well as the Northern California Nevada Regional Conservation Committee. I would like to thank you for the opportunity to express our views.

Some of the comments that I am going to make, kind of parallel the prior speaker but I think I'm going to make them anyway. And also, I'd like to point out that I structured my comments in reference to NEPA and the accuracy of this document as an EIS. And I feel that obviously parallels can be drawn to the requirements of CEQA and the EIR supplement.

[See attached copy of the statement from Frank Stewart.]

Debra Lawhon: That concludes the number of people who have already asked for presentation time. Is there anyone else who would like to say something for the record? If there is no further comment then, this meeting is adjourned. Thank you all for coming.

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November 4, 1988

Mr. James Morrison
Area Manager
Bureau of Land Management
Bishop Resource Area
787 N. Main Street, Suite P
Bishop, California 93514

Reference: PLES I Geothermal Development Project; Draft Environmental Impact Statement/Environmental Impact Report Supplement

Dear Mr. Morrison:

Please find enclosed, Pacific Energy's comments on the Draft Environmental Impact Statement/Environmental Impact Report Supplement prepared for the proposed PLES I Geothermal Development Project. Please contact our office if you should have questions regarding any of our comments.

Thank you for your continued assistance.

Respectfully,

for Michael J. Walker
Manager of Operations - Geothermal

TRT:MJW:me

Enclosures

cc: C. Harvey
D. Liddell
File 3005.4.3.10

T1104881.603

PACIFIC ENERGY COMMENTS ON THE PLES I GEOTHERMAL PROJECT DRAFT EIS/EIR SUPPLEMENT

The following comments are provided on the Draft Environmental Impact Statement/Environmental Impact Report Supplement (Draft EIS/EIR Supplement) prepared for the proposed PLES I Geothermal Project.

Page/Paragraph		Comment
ES-2/¶ 2, and 1-5/¶ 2	8-1	The federal lease (CA-11667) on which the PLES I Project is proposed is 1,510 acres, not 630 acres, as indicated.
2-28/¶ 1	8-2	Since the Draft EIS/EIR Supplement was distributed, Pacific Energy has initiated a demonstration transplanting of mature Jeffrey pines using the tree spade technique. This demonstration has shown that, using this technique, trees in excess of 30 feet in height, even taller than the estimated 20-foot trees suggested in the environmental document, can be transplanted within the proposed project area. Thus, significantly greater immediate vegetative screening of the proposed facilities can be expected than is discussed in the document.
3-14/¶ 1	8-3	The Mesquite Group, Inc. analysis actually indicated that <u>all</u> wells have appeared to have risen relative to the benchmark, and that the subsidence is localized between the Taylor-Bryant fault on the north and the eastern graben boundary fault on the south, which suggests a tectonic relationship.
3-25/¶ 4	8-4	A zero total spring flow from the Casa Diablo Geyser has frequently been observed over the course of historic observations; thus, a range of 0.0 to 1.4 cfs is more accurate.
3-27/¶ 3	8-5	Additional temperature data for the hatchery springs and pools have also been collected by the USGS since 1984 (Farrar, 1988). Continuous temperature data have been taken for the H-2,3 pool (not the spring vents). These data indicate about a one degree Fahrenheit fluctuation annually. This data is consistent with the CDFG data provided in Appendix C of the Draft EIS/EIR Supplement. Furthermore, H-2,3 is the coldest spring group, being essentially the temperature of the cold groundwater, with little or no geothermal component. Fluctuations are mostly reflective of ambient temperature conditions and annual precipitation recharge. The USGS also has collected periodic measurements of the AB spring temperature at random over the last two years, and collected continuous AB spring temperature data since June 1988. Again, these data are consistent with the CDFG data. Pacific Energy has requested a third-party consultant (Mesquite Group, Inc.) to compare the recent USGS data with the historical CDFG data. No direct comparisons are possible because the days of measurement do not coincide; however, paired data taken within a few days of each other were selected for comparison. This tabular comparison is attached to these comments. As can be seen from the attached table, most measurements are within ±0.4°F (±0.2°C) of each other, with the most extreme difference being ±1.1°F (±0.6°C). This is remarkably good agreement, given all the likely problems of instrumentation variance and differences in measurement

	8-5	locus, personnel, and timing. This comparison provides a degree of validation to the more comprehensive historical CDFG data, dating back to 1976.
3-28/¶ 2		It is incorrect to state that the H-2, 3 spring group may be more susceptible to a reduction of the thermal component as its temperature is currently about 51°F, the same as the coldwater springs, and thus has essentially no thermal component. See also comment to page 3-48/¶ 3.
3-28/¶ 3		Figure 1-12 (Appendix C) indicates the temperature of the H-1 spring is 53°F, not 54°F, and that the range is from 52.5°F to 56°F, not 51°F to 54°F.
3-29/¶ 2		There are actually 12 wells drilled within the caldera to depths greater than 2,000 feet. The Sandia well drilled into the west moat and the 2 wells drilled by the Town of Mammoth Lakes were all "cold" (less than 170°F), which directly conflicts with the lateral flow model theory.
3-31/¶ 2		Both temperature and chemistry data from well SF 65-32 are similar to other Casa Diablo wells.
3-43/¶ 3	8-6	Pacific Energy has funded an expanded continuation of the mule deer migration and summer-range survey through 1988. The interim report of the continued survey for the spring migration period is entirely consistent and corroborates the work undertaken in 1987, in that a dispersed pattern of deer activity in, and movement through, the survey area by approximately the same number of deer was noted, and no well-defined migration trails were observed.
3-48/¶ 3	8-7	The third sentence in the paragraph states that a 2°F decrease in the temperature range [ostensibly in the broodstock spawning facilities] would delay spawning until spring and would result in the practical elimination of the Coleman and Hot Creek strains from the hatchery's statewide trout planting program. This is an entirely inappropriate statement which suggests a potential impact that is not feasible given the physical hydrologic environment. The document clearly states that the temperature ranges in the springs supplying the broodstock complexes range from 52.5°F to 56°F for the H-1 spring group and 50.8°F to 54.2°F for the H-2,3 spring group. However, the cold groundwater in the immediate area, as measured by springs in the area with no thermal component such as Laurel Springs, are consistently measured at a temperature of about 51.8°F ±0.5°F. As such, in the extremely unlikely event that the entire thermal component of the springs supplying the spawning facilities were to be lost, the temperature range of these springs could not fall below the temperature of nonthermal springs in the area which in the case of the H-2,3 spring group is already within its recorded temperature range, and for the H-1 spring group could be reduced, at most, approximately 1°F. Thus, it is impossible for the stated impact to the spawning broodstock to occur!
3-50/¶ 2	8-8	In 1987 a group of Native Americans from the Bishop Council, including those most concerned with preserving traditional values, were provided a tour of the proposed project site and thermal features in the Casa Diablo Hot Springs area. The Native Americans were accompanied by the Inyo National Forest, Forest Archaeologist, who was also concerned that proposed project operations may impact some undocumented and

8-8

previously unidentified site considered sacred by the Native Americans. No thermal springs, fumaroles, nor thermally altered areas in the project site were identified to be of cultural significance to the Native Americans.

3-54/¶ 3

8-9

An evaluation of the timber conditions on the PLES I site was conducted by the Inyo National Forest, Mammoth Ranger District, in March 1988. The Forest Service concluded that the merchantable sawtimber available on the site is sparse and of poor quality, and because the young growth was targeted for transplanting around the project site, the Forest Service determined that the timber should be valued as fuel wood rather than as merchantable timber and estimated the volume to be approximately 3.5 cord.

4-2/¶ 5

8-10

The assessment indicates that dust control measures proposed for the project would reduce particulate emissions to acceptable levels. In addition, the principal traffic to and from the project site will be along existing paved roads or along an existing unpaved road which will be paved to the power plant site. Only short, infrequently used, access roads between well sites will be unpaved. As such, we question the need to require a potentially unenforceable mitigation such as a five mph speed limit.

4-12/¶ 4

8-11

While it is correct to state that SEA, Incorporated has determined that a fault may pass through the plant site, it is incorrect to state that ground rupture "could cause ruptured geothermal and isobutane lines, collapse of structures, and human injury" without clarifying that this could occur only if these facilities were located directly over the fault rupture itself. The principal purpose of the trenching recommended by SEA, Incorporated is to precisely locate and classify the fault trace (if any) so that final engineering design can, if necessary, accomodate, relocate, or redesign facilities within the current plant boundary which may now be proposed to cross the fault trace. SEA, Incorporated has formally stated that they believe there is nothing that would prevent construction of the power plant at the preferred site location (Johnson, 1988).

4-13/¶ 5

Again, SEA, Incorporated has stated that they see no reason why the power plant cannot be constructed within the currently proposed power plant site. If the proposed borings encounter shallow cold or thermal groundwaters, then minor relocations of proposed power plant facilities can be made within the confines of the power plant site can be made. It is not at all correct to indicate that the plant site may have to be moved to avoid the shallow groundwater. These are final design details which are properly and routinely resolved after construction permits are issued.

4-14/¶ 3

8-12

The document discusses observed subsidence in the project area and the potential for induced subsidence from geothermal operations. Pacific Energy retained a third-party consultant to review and evaluate the subsidence issue in the Casa Diablo Hot Springs area (Mesquite Group Inc., January 1988). The report of that assessment concluded that the observed subsidence is a result of natural tectonic activity and that the volcanic rocks in the area have structural integrity which do not lend themselves to the compaction subsidence associated with fluid withdrawal. The Mesquite report is provided as an attachment to these comments.

4-26/¶ 1

We recommend the document provide some guidance with regard to cumulative impacts from noise and suggest the following rewording of the mitigation:

8-13

> "Discussion of mitigation measures to deal with the cumulative impact from traffic noise resulting from other proposed projects is best reserved to environmental assessments for those projects which generate substantial traffic and to regional planning documents such as the Noise Element to the County General Plan and the Forest Management Plan."

4-30/¶ 2

8-14

We believe the appropriate mitigation to prevent this spill event from ever occurring is to implement and maintain the emergency spill containment plan and facilities proposed. The suggested mitigation to perform a bioassay of the geothermal fluid is not directly applicable.

4-42/¶ 3

8-15a

While the Draft EIS/EIR Supplement dismisses the results of the "Papadopolus" modeling by redoing the calculations (as indicated above), it does not reject "Papadopolus" nearly as strongly as it should. We believe the major deficiencies of "Papadopolus" should be spelled out explicitly. These deficiencies have been identified and are provided an the attached table.

4-42/¶ 4

8-15b

The numbers provided in the Table are not the same as those provided in Appendix C. The correct values are:

Area	10yrs	20 yrs	30 yrs
Casa Diablo	-5.6°C	-10.7°C	-15.4°C
Hatchery	-0.5°C	- 1.9°C	- 2.6°C
Gorge	0.0°C	- 1.0°C	- 2.0°C

4-43/¶ 2

8-16

PE believes that the statements made in this paragraph are slightly misleading, in that it is not that difficult to predict the potential for geothermal reservoir changes in different areas of the Long Valley Caldera. Three independent, commonly used reservoir modeling techniques have been employed to predict "extreme case" reservoir temperature and pressure changes which could occur in different areas as a result of the PLES I Project. As described, the use of conservative reservoir values in the modeling means that the actual changes will be substantially less than those predicted. Maximum temperature and pressure changes of -15.4°C and +2.2 psi were predicted in the Casa Diablo reservoir and -2.6°C and +0.55 psi in the Hot Creek Hatchery reservoir after 30 years of PLES I Project operation. As noted, a pressure change of +2.2 psi in the Casa Diablo reservoir is insignificant, although the "extreme case" prediction of a 15.6°C temperature decline in the Casa Diablo production reservoir would probably decrease the ability of the power plant to operate efficiently.

Although the model calculations described above and in Appendix C indicate that, even assuming hydraulic communication exists, the potential for significant subsurface changes to extend the three to five miles to Hot Creek Hatchery and Hot Creek Gorge is very low. What is more difficult to precisely predict is the effect that these small predicted temperature and pressure changes in the geothermal reservoir will have on surface thermal features at the Hot Creek Hatchery and certain other areas distant from the Casa Diablo geothermal area. Special

circumstances exist at each of these thermal areas, such as those at the hatchery springs, where it is estimated that approximately 2% to 3% of the flow is thermal water. The temperature of the thermal fluid component of these springs is unknown; but it is estimated that a loss of the entire thermal component could result in a lowering of average spring temperature of 2° to 3°C (Sorey, M.L., 1976). No effects have been measured at Hot Creek Gorge or hatchery springs to date, and none would be anticipated on the basis of the reservoir measurements made to date at Casa Diablo.

8-16

Based upon the minor changes in reservoir temperature and pressure predicted to occur under these "extreme case" examples, and the nature of the hydrothermal connection to the surface, especially in the case of the Hot Creek Hatchery, it is extremely unlikely that any significant impacts would occur to these distant thermal features of concern.

4-47/¶ 2-3

The text of this paragraph presents a very sketchy and incomplete overview of the hydrothermal monitoring and mitigation programs proposed as part of the project description. Because an accurate understanding of the purpose, design and implementation of these programs is critical to determining how they will be effective, we suggest you replace these paragraphs with the following.

> "This "mitigation process" was designed to reduce to insignificance the possibility of impacts to any of the sensitive hydrothermal features by implementing a program of monitoring the hydrothermal system at numerous points to detect any potentially adverse changes so that mitigation measures could be implemented before those changes reach the sensitive hydrothermal features. This hydrothermal system monitoring program would establish additional baseline data, detect changes caused by project operations before they could affect hydrothermal features of concern, provide information to select and implement appropriate mitigations to prevent hydrothermal changes from migrating away from the production field toward the sensitive hydrothermal features and monitor the effectiveness of the implemented mitigation. The data to be collected by the operator are listed in the Plan for Baseline Data Collection discussed in Chapter 2.
>
> "The proposed monitoring program is progressive; that is, the results of initial monitoring may result in the establishment of additional monitoring, and possibly the drilling of additional monitoring wells. It was designed to provide documentation of any progressive movement of hydrothermal system changes away from the Casa Diablo project area toward the Hot Creek Hatchery and other areas of concern. Finally, it was intended to provide the information necessary to select, implement and monitor those mitigation measures appropriate to prevent any detected adverse hydrothermal system changes from reaching the thermal features of concern.

8-17

"The proposed hydrothermal mitigation program consists of several techniques which are commonly used in geothermal and oil and gas wellfield operations to manage pressure changes within the reservoir. Geothermal wellfield operations basically consist of the production and injection of large quantities of water so that the heat in the reservoir can be extracted. To produce water from a geothermal well, the pressure in the well is reduced so that the water flows from the geothermal reservoir into the well, and then to the surface. Injection wells reverse this process; increasing the pressure in the injection well forces the water into the injection reservoir, slightly increasing the reservoir pressure in the injection zone.

"Many decisions are made in the process of the development of a geothermal wellfield, such as the location and depth of the production and injection wells; the quantity of water produced or injected; or the number of production and injection wells, all of which affect the specific flow paths of the water in the subsurface geothermal production and injection zones. For example, as previously indicated, since the proposed injection area is to the east of the proposed production area, the injection wells will create a zone of slightly increased reservoir pressure between the area of slightly decreased reservoir pressure in the production zone and the hydrothermal features of concern, such as the Hot Creek Hatchery springs. Because water flows in response to pressure changes, by changing the way in which the project produces and injects the geothermal fluid it is possible to modify the way in which the geothermal water flows in the reservoir and, thus, mitigate changes which are detected in the geothermal reservoir which may migrate towards the hydrothermal features of concern. By implementing one or more of the proposed geothermal mitigation measures, the operator, as directed by the authorized officer, should be able to prevent the detected adverse hydrothermal system changes from reaching the thermal features of concern.

8-17

"Finally, as a mitigation measure which would be implemented only in the unlikely circumstance that the monitoring and wellfield mitigation measure program failed to prevent the migration of adverse reservoir changes, the hydrothermal mitigation process required that the operator provide an alternative source of thermal water to the affected Hot Creek Hatchery headsprings. This alternative source of water was to be conveyed to the Hot Creek Hatchery headsprings in a manner that did not introduce other fish into the headsprings, and was to be maintained for as long as an alternative source of thermal water was needed to maintain temperatures at levels existing prior to the onset of impact from project operations.

"Impact: This hydrothermal mitigation process is quite comprehensive and, as summarized, is designed to reduce to insignificance the possibility of impacts to hydrothermal features of concern. However, several potential insufficiencies have been identified. First, although the California Department of Fish and Game (CDFG) is responsible for the continued operation of the Hot Creek Hatchery, they were not included as one of the "consulting agencies"; the same was true of the U.S. Forest Service with respect to the Hot Creek Gorge springs. The LVHAC monitoring program has now been revised and updated, effective May, 1988. The proposed process ignores the potential for an increase in hydrothermal flow and, therefore, temperature, at the Hot Creek Hatchery springs. The process is also silent on the means by which the authorized officer will determine when to implement any of the additional monitoring or mitigation measures; no method to establish "trigger points" is identified. Finally, the program did not address any issues regarding the timing of the implementation of the mitigation measures designed to correct and prevent any adverse impacts to the thermal features of concern. In order to correct these potential insufficiencies, the following replacement mitigation is suggested."

8-17

4-47/¶ 5

The process is more correctly described as a "monitoring and remedial action program designed to prevent, or mitigate, potential hydrothermal impact to the Owens tui chub critical habitat, Hot Creek Hatchery, and Hot Creek Gorge springs."

4-47/¶ 6

8-18

The current version of the LVHAC monitoring program is dated May, 1988.

4-48/¶ 1

This proposed mitigation measure deviates from that contained in the project description by requiring the drilling and completion of a "second" monitoring well (in addition to the already completed SF 65-32 monitoring well) prior to the start of commercial operations. There is absolutely no justification for completion of this well prior to commercial production presented anywhere in this environmental document, nor is there any valid technical argument to support its completion other than under the originally proposed criteria! This condition should be deleted and replaced with that presented on page 4-44, paragraph 2.

8-19

Pacific Energy has previously committed to drilling one observation well prior to commercial production. This well, SF 65-32, was drilled and completed in December 1987, at a location (±1,300 ft east of SF 35-32) and according to procedures previously agreed to by the BLM and the LVHAC. Pressure, temperature and chemical data clearly indicate that this well is in communication with the Casa Diablo production reservoir. Thus far, a "stabilized" pressure drawdown of less that two psi is observed at the well when the MP I project is operating at maximum capacity. This is obviously an inconsequential effect with respect to the warm springs at the fish hatchery some three miles to the east, as even this document recognizes (page 4-39). No changes in temperature or chemistry have been observed.

Pacific Energy has also previously committed to drilling a second observation well near Colton Spring, if it is determined that there is a need for supplemental monitoring data based on the information developed from the first well. This was clearly intended to be a progressive process whereby potentially detrimental changes in or near the geothermal field (i.e., at the first well, SF 65-32) would trigger the drilling of the second well, about a third of the way to the hatchery, in order to determine if the change was propagating in that direction.

It should be noted that a monitoring well at Colton Spring would still be within the Casa Diablo graben. Thus, with either model of the hydrothermal system, i.e., Lateral Flow or Fracture Upwelling, clearly measurable changes could occur at Colton as the result of normal changes in the geothermal field. However, only if the Lateral Flow model is correct, could such changes eventually propagate to the hatchery two miles further east.

The definitive observation well with respect to identifying a true threat to the hatchery springs was previously envisioned as being located about midway between Colton Spring and the hatchery head springs. Pacific Energy has also committed to drilling this third observation well if significant changes are observed in the Colton Spring area well. Thus, if there is a progressive (but predicted diminishing) change from the geothermal field to SF 65-32, then to the second observation well and then to the third observation well, cause and effect can rightly be presumed. Note that simply drilling the third well is insufficient, as changes due to the proposed Mammoth/Chance Project operations or natural phenomena cannot be distinguished from those due to the Casa Diablo geothermal projects without the intervening two observation wells to define a progressive effect.

8-19

The proposed change in the monitoring process now deviates from the previously agreed upon plan by requiring that the second observation well (i.e., near Colton Spring) be drilled "prior to the start of commercial production". In our opinion, there is no technical justification for requiring that this well be drilled prior to observing a substantial change in the first observation well. While the magnitude of what constitutes a "substantial change" can be subject to argument, no responsible technical expert is likely to argue that the currently observed, less than two psi operating pressure drawdown at the first observation well is substantial. This is especially true when it can be demonstrated that the pressure in the production wells and the observation well returns to its initial static condition (within the limits of measurement accuracy) in a very short time after shut-down (e.g., one to two hours in the producers, one to two days in SF 65-32). This means that the surrounding reservoir is not being depleted by present operations and that, at some small distance from the field, the hydrothermal system is undisturbed relative to its natural condition.

The Draft EIS/EIR Supplement itself states (pg. 4-39) that "any response, positive or negative, less than 10 psi in the producing area of Casa Diablo is not considered significant". Thus, the rationale for requiring a second observation well to be completed prior to commercial operations simply does not exist at the present time. Proposing to require the second observation well prior to detecting significant change in the first is an approach which we believe has no technical merit.

4-48/¶ 3

This condition sets "trigger points" for the implementation of mitigation principally on the basis of pre-production data and conditions, rather than on variations from predicted changes to the commencement of production. It is not reasonable to expect that imposition of the PLES I Project will not cause "any variation outside their normal ranges based on data collected prior to production at PLES I". MP I operations currently result in a very small, but definable, less than two psi pressure drawdown at SF 65-32. With the imposition of PLES I operations, a new semi-steady state is expected to be established. Additional operating pressure drawdown at SF 65-32, roughly proportional to the additional fluid withdrawals due to PLES I operations is to be expected. If MP II operations are also added, current models of the reservoir predict about a 10 psi operating pressure drawdown at SF 65-32. The fact that it deviates from the "normal range" established by measurement prior to PLES I production is not a reason in itself for triggering mitigation actions.

What needs to be determined is whether a 10 psi decrease in pressure at Casa Diablo can reasonably be expected to have any impact at the fish hatchery three miles away. It is our opinion that such a change will be inconsequential, with the 10 psi drawdown dissipating rapidly with distance away from the field. Furthermore, we believe that most technical experts familiar with the Long Valley hydrothermal system would agree with us that a 10 psi drawdown is not significant, as do the authors of the Draft EIS/EIR Supplement (pg. 4-39).

8-20

At the point in time, some two years hence, that such an operating pressure drawdown may be experienced, the available data base will be much more extensive. In addition to the baseline data available pursuant to the LVHAC monitoring programs, the results from drilling, testing and initial operation of the wells associated with PLES I (and MP II) will be available. The ability to numerically model the reservoir performance will be greatly refined by this time. It should then be much more meaningful for the various technical experts to advise the controlling regulatory bodies as to the significance of any observed changes at Casa Diablo. We expect that a ±10 psi drawdown will still be considered inconsequential. On the other hand, a ±20 psi drawdown, which substantially exceeds expectations and continues to decline, could indicate that the available recharge is unable to keep up with the increased withdrawals. This might well be judged to warrant drilling the second observation well and implementation of mitigation measures such as modifying the injection distribution in order to maintain pressure. Likewise, a potentially detrimental change in produced fluid chemistry or declining resource temperature of more than a few degrees could also be legitimate causes of concern, particularly because no such changes are currently expected.

The point is that the requirement for additional monitoring wells and mitigation measures is best left with the responsible regulating body who will be advised by technical experts (internal and external) on the basis of actual observations and data available at the time. To require, at this time, that any deviation from the current "normal range" trigger additional mitigation is not technically defensible. This is especially true when we already predict and expect small changes to occur due to additional development, which are currently judged to be inconsequential.

4-52/¶ 3 **8-21** Replace or revise in accordance with previous comments on 4-48/¶ 1.

4-53/¶ 3 **8-22** Revise in accordance with previous comments on 4-48/¶ 3.

4-56/¶ 4

There is absolutely no justification for the drilling of this injection zone monitoring well presented in this document, so we can only presume that this newly proposed mitigation measure is mainly predicated upon the numerical pressure response modeling done for this Draft EIS/EIR Supplement. This model predicts that reservoir pressure will increase a small amount (i.e., 2.2 psi at SF 65-32, and 0.55 psi at the hatchery) on the east side of the field, thereby causing a minor increase in the hydrothermal component flow near the hatchery. This, in turn could potentially cause a minor temperature increase in the hatchery springs.

However, such a pressure increase in the injection zone at the Casa Diablo can already be monitored directly with the data from the annual pressure fall-off surveys conducted in the injectors. Thus far, no increase in injection reservoir pressure is indicated. Furthermore, injector wellhead pressures and downhole pressure in one injector are now being continuously monitored during injection. Any anomalous increase in operating injection pressure can thus trigger a shutdown at any time of the year to measure the fall-off to static reservoir pressure. This will insure that no pressure increase in the injection reservoir will go undetected. **8-23**

Thus, there is really no need for an injection reservoir observation well to detect an increase in pressure. Furthermore, the Draft EIS/EIR Supplement itself states (pg. 4-54) that:

> "It should be noted that it is considered exceedingly remote that pressure in the hydrothermal reservoir would rise, resulting in increased temperatures. The predicted very small pressure increase occurs because the model assumes complete hydrologic communication between the production and injection reservoirs. In reality, it is unlikely that there is such communication. Therefore, although no detectable impact is expected, of the two possibilities, a decrease in the thermal component is the more likely."

While we don't necessarily agree that there is no communication between the production and injection reservoirs, we do agree that there is no current direct evidence of communication. Pressure in the production reservoir is actually being maintained at present by additional hydrothermal influx, (i.e., recharge from below or laterally) not by injection. What is observed is actually a less than two psi decrease in operating pressure at SF 65-32 in the production reservoir, not a two psi increase as predicted by the EIS/EIR modeling due to injection.

From the foregoing it should be clear that monitoring pressure in the injection reservoir with a new observation well is unnecessary. Not only is a pressure increase due to injection exceedingly unlikely, but pressure will be monitored directly from the injectors themselves during each shutdown.

More recently, a concern about temperature decline at the hatchery and Hot Creek gorge caused by injection cooling at Casa Diablo has been raised by the S.S. Papadopulos & Associates, Inc. report commissioned by the California Dept. of Fish and Game. This is a different process with an effect opposite that produced by the pressure response modeling which caused the initial concern about monitoring the injection zone.

The Draft EIS/EIR Supplement considers the "Papadopulos" possibility and dismisses it as a non-problem by: (1) doing bulk-model calculations (pg. 4-40) which show that the cool temperature front due to injection will move out only a short distance from the field (i.e., less than 1,300 feet) during the project life; and (2) repeating the Papadopulos heat balance modeling approach (pg. 4-42) while correcting a few (of many) of the fundamental assumption errors in Papadopulos' modeling, with the result being no cooling at the hatchery or Hot Creek gorge due to Casa Diablo operations.

"Papadopulos" postulates that this cooled injection zone will eventually migrate with the regional flow to the hatchery area. Migration calculations in the Draft EIS/EIR Supplement (pg. 4-41) also indicate that the cooled injection zone could reach the hatchery area in about 100 years, if the zone maintained its integrity. However, it was noted that the cooled zone could not really migrate intact, but rather would tend to sink deeper into the reservoir, (pg. 4-41), and would be reheated by the hot reservoir rock as it moves from west to east. The reheating potential was not calculated in the Draft EIS/EIR Supplement, but a simple heat balance calculation shows that the 80°C water in the cooled zone will be reheated by the rock to 130.6°C (or 1.6°C less than the current Mammoth/Chance reservoir temperature of 132.2°C) by the time it reaches the hatchery area. Only one percent of the heat in this rock is required to achieve this. The basic input values for the calculation are the same as those used in the bulk model calculation, and further assume piston-like displacement of the cooled zone water (i.e., no benefit of mixing with hotter waters upstream or downstream) and an average rock temperature of 141°C between Casa Diablo (150°C) and the hatchery (132°C) area. Because the hydrothermal component is about three percent of the total spring flow at the hatchery, the spring temperatures would actually then decline only 0.04°C on average. Given the range of normal variation, such a decline would be undetectable for all practical purposes.

8-23

As a result of the foregoing it should be clear that cooling of the springs at the hatchery due to Casa Diablo injection is not a problem. Thus, again, there should be no need to directly monitor the temperature in the injection zone with a monitoring well.

Likewise, chemical changes in the injection zone fluids are not a problem. The binary power cycle at Casa Diablo is a non-consumptive closed cycle. The injected waters are chemically identical to the produced waters and can obviously be monitored directly with surface sampling.

In summary, the only potential for detrimental change in the injection zone is a very unlikely pressure increase. This can be monitored directly with periodic pressure fall-off surveys in the injectors themselves. As a consequence, we do not believe there is any justifiable technical

8-23

reason at this time for a separate well to monitor the injection zone. However, if for any reason the drilling of an injection zone monitoring well becomes desirable, other proposed conditions give the authorized officer authority to require the drilling of an injection zone monitoring well.

4-66/¶ 5

8-24

This paragraph seems to be referring to mitigation of visual impacts rather than those associated with deer. With regard to mitigation of potential impacts on mule deer migration, Pacific Energy has: (1) adopted former BLM stipulation No. 12 (Draft EIS/EIR Supplement, page 2-6), which states that noise intensive activities during deer migration periods may be limited; and (2) agreed to construct pipeline crossing ramp(s) for mule deer which would be constructed, as may be required by the BLM authorized officer. An engineering detail of the proposed mule deer crossing ramp design was earlier provided to the BLM (Detail "L" on Drawing No. C-0416-1-E-108, PLES I Facilities, Details and Specifications) and is provided as an attachment to these comments.

4-66/¶ 6

8-25

This mitigation measure should read:

> "No mitigation measure other than those proposed by the applicant is recommended."

4-91/¶ 11

8-26

As discussed in earlier comments, the ability to transplant even larger mature Jeffrey pines, in excess of 30 feet in height, taller than earlier anticipated, provides the opportunity of meeting the Forest Service VMO for retention in the project area almost immediately, or at least in a much shorter time frame, by vegetative screening of the proposed facilities.

4-102/¶ 7

8-27

The following economic impact associated with the smaller power plant should be added:

> "Economic benefits to the federal government from royalty revenues; and to the local economy from property taxes, County of origin revenues, local employment, local spending and sales taxes would be proportionally less for the smaller power plant than for the proposed project.

5-3/¶ 3

8-28

The following individuals should be added to the list of individuals in private organizations contacted:

- Environmental Management Associates, Inc.

  Dwight L. Carey, D.Env.

- Pacific Energy

  Claude Harvey, Vice President

- Pacific Enterprises

  Donald C. Liddell, Special Counsel

Appendix F
F-1/¶ 6

8-29

The statement that PURPA and the CPUC require electrical utilities to purchase electricity from small power producers at "a higher price than the utilities would pay a large conventional fuel electrical producer" is inaccurate. Instead, the act and the implementing agency require a utility to buy electricity at the price the utility "avoids" by not having to build its own generating capacity.

Appendix F
F-2/¶ 3

8-30

With regard to the potential for additional geothermal development in the project area it is important to note that, to date, only the isolated Casa Diablo Hot Springs area has been proven to have commercial geothermal potential. Further, both the Inyo Domes Unit operator, Unocal, and the Long Valley East Unit operator, Santa Fe Geothermal, have both gone on record announcing that they have no plans for development in the project area in the foreseeable future.

Appendix F
Figure 1

8-31

This figure identifies existing development in the project area and shows a developed area (Area D) as the site of the MP I geothermal project. This is in error, and the large developed area shown is actually undeveloped private land owned by the Los Angeles Department of Water and Power (LADWP) and is not associated with the MP I project. The MP I project is actually within an area immediately east (identified as proposed project area No. 6). The relatively small (approximately 170-acre) MP I project area is also the site of the proposed MP II and MP III projects. Finally, the larger area surrounding the LADWP property and the MP projects is the Pacific Energy federal lease in which the PLES I project area is proposed.

Appendix F
F-5/¶ 3

8-32

This paragraph discusses several public projects proposed within, or near the Town of Mammoth Lakes. We recommend redrafting the paragraph as follows:

> "Town of Mammoth Lakes Projects: Three public agency-sponsored projects are proposed for development within, or near, the Town of Mammoth Lakes, including the: (1) Town of Mammoth Lakes Golf Course; (2) Mammoth Water District Water Project; and (3) Economic Development Corporation plans for an Industrial Center at Old Mammoth School.

Appendix F
F-5/¶ 4

8-33

We understand the decision to dismiss from consideration the issue of cumulative hydrologic impacts from the projects identified. However, we believe this decision may not be clear from the information provided in the Draft EIS/EIR Supplement. As such, we recommend adding the following clarifying language to the paragraph:

> "The following projects were evaluated in the cumulative impact assessment in this document; however, for the reason identified for each project, it was determined to be inappropriate to analyze the potential cumulative hydrologic impacts from these projects with respect to the proposed PLES I project."

COMPARISON - USGS VS. CDF&G

WATER TEMPERATURES (^{o}F)

HOT CREEK HATCHERY SPRINGS

AB Group			H-2,3 Group		
USGS	CFD&G	Δ T	USGS	CFD&G	Δ T
60.8 (6/21/84)	60.7 (6/25/84)	0.1	52.0 (6/21/84)	51.7 (6/25/84)	0.3
60.6 (4/28/85)	60.0 (4/17/85)	0.6	51.4 (4/28/85)	51.3 (4/17/85)	0.1
59.9 (4/8/86)	59.8 (4/14/86)	0.1	51.8 (4/8/86)	50.9 (4/14/86)	0.3
-	-	-	51.6 (7/19/86)	51.4 (7/15/86)	0.2
-	-	-	52.0 (8/29/86)	51.8 (8/1/86)	0.2
62.6 (10/16/86)	62.3 (11/5/86)	0.3	52.2 (10/16/86)	51.7 (11/5/86)	0.5
-	-	-	52.7 (11/18/86)	51.7 (11/5/86)	1.0
61.0 (4/21/87)	61.2 (5/4/87)	0.2	51.4 (4/21/87)	51.4 (5/4/87)	0
61.5 (5/27/87)	61.8 (6/4/87)	0.3	51.4 (5/27/87)	51.8 (6/4/87)	0.4
-	-	-	51.4 (6/18/87)	50.8 (6/23/87)	0.6
-	-	-	51.8 (7/28/87)	51.6 (7/27/87)	0.2
63.1 (7/31/87)	62.0 (7/27/87)	1.1	52.2 (7/31/87)	51.6 (7/27/87)	0.6

CD Group			H-1 Group		
USGS	CFD&G	Δ T	USGS	CFD&G	Δ T
57.9 (4/28/85)	57.4 (4/17/85)	0.5	55.2 (4/28/85)	54.2 (4/17/85)	1.0

(Source: Mesquite Group Inc., 1988)

Mesquite Group, Inc.

P.O. Box 1283
136 W. Whiting Avenue
Fullerton, California 92632
(714) 738-8224

January 27, 1988

Mr. Donald C. Liddell
Senior Counsel
Pacific Lighting Energy Systems
6055 E. Washington Blvd.
Commerce, CA 90040

Subject: Review and Evaluation of Subsidence in the Casa Diablo Area, Long Valley Caldera, Mono County, California

Dear Don:

Pursuant to your request last month, we have now completed the subject subsidence review and evaluation. A short report documenting this effort is enclosed.

Briefly, our conclusion is that the observed subsidence in the Casa Diablo area is in no way related to the geothermal operations. The subsiding area actually constitutes the Casa Diablo Graben and is, in our opinion, a normal tectonic event which has characterized the area for thousands of years. Furthermore, the current subsidence is centered 1,500 feet south of the geothermal plant, and its onset was more than two years after plant start-up.

The only detectable subsidence within the geothermal field area occurred between mid-1986 and mid-1987 near the plant site, and is less than 0.02 feet. This amount of movement is minor in comparison to other elevation changes observed in the Long Valley Caldera in in recent times. Even if subsidence continues at this rate in the field area, it will be a widespread phenomena which clearly poses no threat to facilities or the environment.

The available data and evaluation leading to this conclusion are detailed in the enclosed report. Please call if you have questions or wish further elaboration.

Sincerely,

Don A. Campbell

DAC:mjo
Enclosure
cc: Dr. M.L. Sorey, USGS
Mr. Terry Thomas, EMA

Mesquite Group, Inc.

P.O. Box 1283
136 W. Whiting Avenue
Fullerton, California 92632
(714) 738-8224

REVIEW AND EVALUATION OF SUBSIDENCE IN THE CASA DIABLO AREA, LONG VALLEY CALDERA, MONO COUNTY, CALIFORNIA

Introduction

Dr. J.S. Savage of the U.S. Geological Survey (USGS) stated in the July-September 1987, Long Valley Caldera Monitoring Report that "the most prominent signal is the subsidence over the 1 km section that crosses the Casa Diablo geothermal field. That subsidence, which appears in both plots, amounts to about 15 mm/yr near the center of the field". Savage presented several figures (included as Appendix A) intended to support this interpretation. These data were referred to in the covering page of the report with the statement "the local subsidence associated with the Casa Diablo geothermal field that began following the onset of routine power production from the geothermal power plant in 1984". Note that Savage's original statement did not correlate subsidence to production, only to location.

Concern about possible complications arising from subsidence associated with field operations caused Pacific Lighting Energy Systems (PLES) to request that Mesquite Group, Inc. (Mesquite) review and evaluate all the available subsidence data. Mesquite initiated the required data compilation by requesting Dr. Savage's raw leveling data (1982-1987), Gram-Phillips'/Ben Holt's original well location/elevation survey data (1982 and 1984), and Western Air Photo's 1987 topographic survey data. The discussion below summarizes the available data base and Mesquite's evaluation thereof.

Leveling Data

The National Geodetic Survey (NGS - formerly the Coast and Geodetic Survey) installs elevation bench marks along lines throughout the United States. Periodically, the NGS precisely determines the location and elevation of these bench marks, an operation called "leveling". The Long Valley leveling line extends from Tom's Place in the south to Lee Vining in the north. The line usually follows the route of Old Highway 395 (i.e., Hot Springs Road). At present, bench marks are spaced approximately 700 feet apart across the resurgent dome in the Casa Diablo area.

The data that Dr. Savage transmitted to Mesquite included the physical location of the bench marks in Long Valley and the results of previous leveling surveys that were performed in 1932, 1957, 1975, 1980, 1982, 1983, 1984, 1985, 1986, and 1987. The increased frequency of measurement begun in 1980 reflects the USGS's expansion of their Long Valley Volcanic Hazards Monitoring Program. During this time the number of bench marks was greatly

increased across the resurgent dome.

Mesquite reviewed the data and selected the 1984 survey as a baseline. This survey was performed before commercial production operations began and contained all of the newer bench marks. The elevation of each bench mark in subsequent annual surveys was compared to the elevation in 1984 and the relative difference was calculated. The annual elevation change relative to 1984 is plotted in Figure 1 for the Casa Diablo area. In general, the resurgent dome (including Casa Diablo) has risen over 0.5 feet since 1984. However, between the last two surveys (1986 and 1987), the rise appears to have stabilized regionally, and a 4,000 foot wide section of the dome actually subsided a maximum of approximately 0.06 feet. This subsidence is greatest at the Casa Az bench mark, which is located near the intersection of Old 395 and Route 203 (Plate 1). At the Z123 bench mark, across the road (Old 395) from the Mammoth-Pacific I (MP I) power plant, the measured subsidence amounts to less than 0.02 feet. Geographically the subsidence extends from near the Mammoth Creek crossing of Old 395 on the south to the Southern California Edison (SCE) Substation on the north.

Well Survey Data

Well surveys, which include location coordinates and ground elevations, are usually finalized immediately after a well is drilled. The original MP I well surveys and accompanying field notes were obtained from the Gram/Phillips Associates, Inc. (local surveyors) and the Ben Holt Company (the MP I Project contractor). These data were mostly from 1982, before the MP I wells were drilled, and thus the actual ground elevations at the new wells may be slightly different than the surveys due to site grading. However, surveys were also done at this time for two of the already existing wells in the area, i.e., Union-Mammoth 1 and Endogenous 1, and these surveys should be exact. In addition, 1984 survey data, after drilling, were provided for two of the new MP I wells, MBP 3 and IW 1.

The reported ground levels for each well were first adjusted relative to the NGS reference point (BM Z123) elevation in the year of the survey (Plate 1). This was necessary because Gramm/Phillips had assumed the 1980 elevation of BM Z123 to be a constant reference for their surveys, while the NGS date showed movement from year to year. These adjusted elevations were then compared with the elevations shown on the 1987 air photo topographic map prepared by Western Air Photo (which was referenced to the correct 1987 NGS elevation for BM Z123). The total change in well elevation between the original survey (1982 or 1984) and 1987 was then calculated as shown on Table 1. Each well's movement relative to the bench mark was also determined by subtracting the movement of the bench mark (Z123) in this period and this is plotted in Figure 2. Similar calculations for the other NGS bench marks in the area are also shown on Table 1 and plotted in Figure 2.

not rise as fast as the other resurgent dome bench marks. Between 1986 and 1987, the resurgent dome uplift generally stabilized and slight subsidence (maximum of 0.06 feet) occurred in the Casa Diablo area. The subsidence area is a 4,000 foot wide zone centered near the junction of Old 395 and 203. At the MP I Plant, the elevation decreased only 0.02 feet.

The lack of precise annual surveys of well elevation comparable to the NGS surveys prevents a detailed analysis of surface movement in the field area. However, a gross comparison of the original well surveys (1982 or 1984) and one in the fall of 1987 is possible. Taken literally, the data indicate that the geothermal field (both injection and production areas) has moved up nearly twice as much as the general regional uplift between 1982 and 1987 ($\pm$1.0 feet vs $\pm$0.5 feet), as shown on Table 1 and Figure 2. There are no 1986 well survey data available to indicate whether the recent minor subsidence consistent with the NGS leveling line movement has occurred. Nevertheless, it is clear that no subsidence of any consequence has occurred within the field area, and that an overall a rise of 0.5 to 1.0 feet dominates elevation changes in the area since 1982.

Geologically, the recent subsidence observed along the NGS leveling line appears to be related to tectonic movement of the Casa Diablo Graben. The subsidence only occurs east of the Taylor-Bryant Fault and west of the eastern Casa Diablo Graben Boundary Fault. Such tectonic movement is seen throughout eastern California and Nevada where the grabens (i.e., down-dropped fault blocks) move down in relation to the adjacent horsts (i.e., raised fault blocks). In fact, the Casa Diablo Graben is an easily mapped feature that extends for over three miles in a very young volcanic terrain. This indicates that the graben has experienced active down dropping for at least the past 60,000 years. Subsurface correlation between the three MP I injection wells clearly shows that the Casa Diablo Graben has moved approximately 400 feet downward in relation to the eastern horst during recent geologic time.

It should also be pointed out that the types of rock found in the Casa Diablo area do not readily lend themselves to subsidence which is not tectonically induced. Classical subsidence associated with fluid production occurs above sand/shale reservoirs as individual grains of rock compact in response to reductions in pore fluid pressure. Dr. M.L. Sorey has recently suggested that a similar compaction phenomena might result from rock contraction associated with cooling due to injection. However, the volcanic rocks involved at Casa Diablo generally have structural integrity which minimizes or precludes compaction. Porosity is almost exclusively vertical fractures, which may close in response to pressure decline or open in response to cooling, but such movements do not have significant vertical components. Furthermore, there has been no change in average reservoir pressure in the production area or the injection area which could induce movement. Contraction due to cooling of the injection interval rock remains a theoretical possibility, but there is no indication of movement in the injection area which is not consistent with the regional tectonic movements.

TABLE 1

WELL ELEVATION CHANGES

Well or Benchmark	Original Survey Elevation (ft ASL)	Year	1987 Elevation (ft ASL)	Total Elevation Difference (ft)	Movement Relative to BM Z123 (ft)
Endog. #1	7334.05	1982	7335.0	0.95	0.4
Union Mammoth #1	7305.98	1982	7306.8	0.82	0.3
MBP #3	7310.25	1984	7311.3	1.05	0.5
IW #1	7294.96	1984	7295.8	0.84	0.3
EGE 6	7333.10	1983	7333.55	0.45	-0.1
Z 123[a]	7290.10	1982	7290.63	0.53	0.0
EGE 7	7272.81	1983	7273.19	0.38	-0.2
CASA AZ[b]	7249.74	1982	7250.19	0.45	-0.1
DBR 11	7250.89	1984	7251.37	0.48	-0.1

(a) Bench mark across Old 395 from the MP I plant.

(b) Bench mark at the intersection of Old 395 and 203.

The movements suggested by the well survey data range from +0.3 to +0.5 feet more than the 0.53 foot upward movement of BM Z123 between 1982 and 1987. This implies that the wells have risen nearly a foot, or twice the regional uplift. This is not really believable in Mesquite's opinion. More likely, the wells have moved similarly to the bench mark and there is some systematic difference between surveys. Such a difference is not surprising, in that the well surveys were not conducted with the precision of the NGS survey. Western Air, in fact, only claims an accuracy of $\pm$0.3 feet. Nonetheless, the consistency of the data is such that the wells are clearly indicated to have risen in the 1982 to 1987 period, and no subsidence is evident.

Discussion

The NGS elevation data shows that the Casa Diablo area has generally risen an average of 0.5 feet since 1984. This elevation gain is associated with the upwarp of the resurgent dome resulting from hypothesized deep magma injection, and is known to have begun well before the geothermal project start-up in late 1984. Between mid-1985 and mid-1986, the bench marks along Old 395 from near the SCE substation to Mammoth Creek (Figure 1) did

Conclusion

The 1986-87 subsidence observed in the Casa Diablo area has actually been relatively minor when compared to elevation changes elsewhere in the Long Valley Caldera during the period of historic observation. In Mesquite's opinion, the subsidence of the Casa Diablo Graben is merely a resumption of tectonic down-dropping which has characterized the area for thousands of years. The fact that geothermal operations are being conducted in the graben has no correlatable relation to the observed subsidence.

The overall evidence for this conclusion may be summarized as follows:

1) The apparent onset of recent subsidence was actually more that two years after operations began at MP I.

2) The subsidence is centered 1,500 feet south of the MP I power plant and extends for over 4,000 feet along Old 395. The geothermal operations are located on the far northern flank of the subsidence area and could not reasonably be expected to impact the area in a manner that caused subsidence to be projected southward.

3) Well survey data indicates that the production and injection areas have moved upward in concert with the NGS leveling line. This data does not show any subsidence associated with either production or injection.

4) Geological evidence indicates that the recent observed subsidence is related to normal tectonism of the Casa Diablo Graben.

5) There has been no average reservoir pressure decrease in the production area or increase in the injection area which could induce movement. Cooling of the injection area is a theoretical possibility, but this area has predominantly moved up.

6) The volcanic rocks involved generally have structural integrity and do not lend themselves to compaction which results in subsidence.

FIGURE 1

ELEVATION CHANGES

JUNE 1984 TO YEAR INDICATED

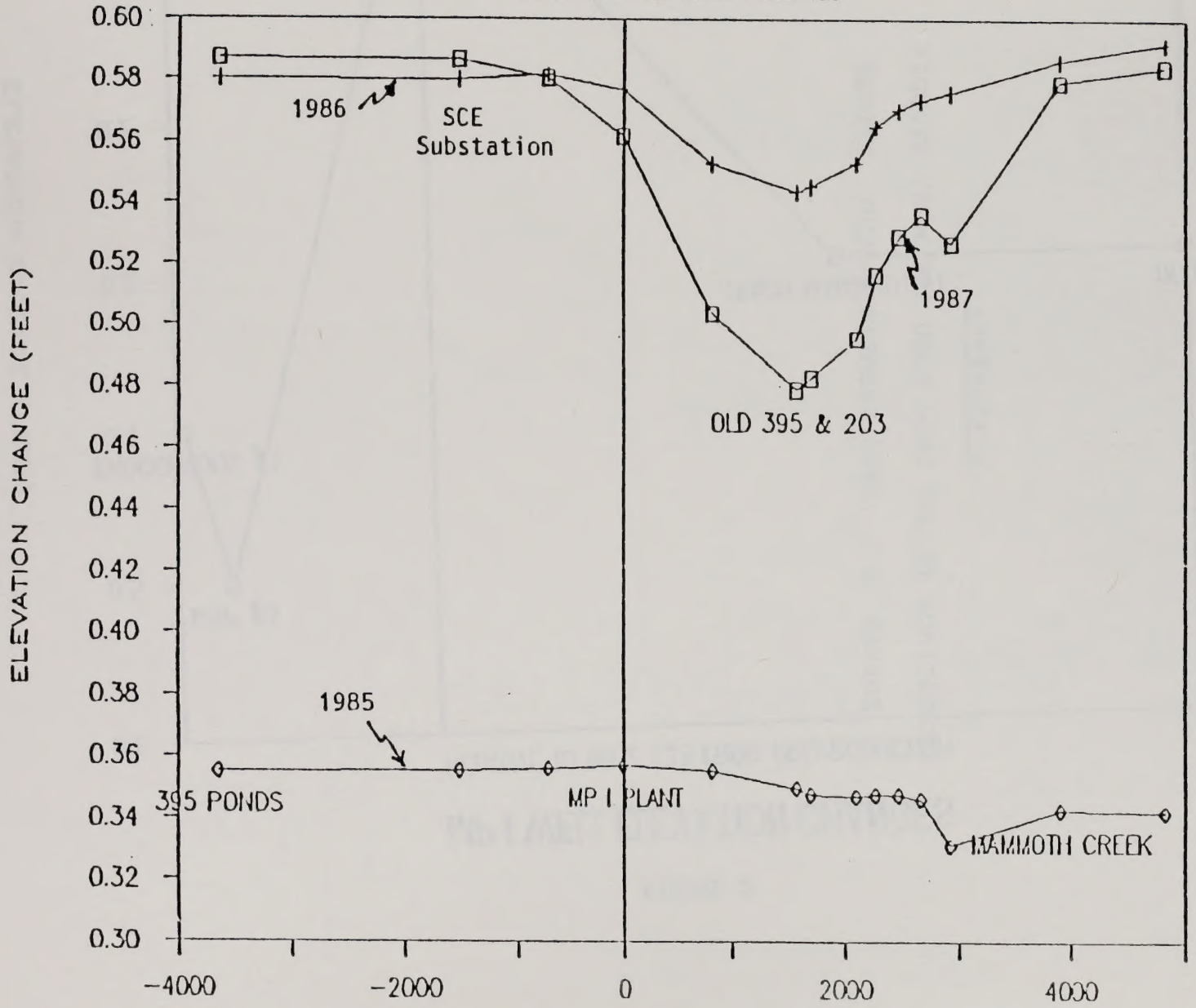
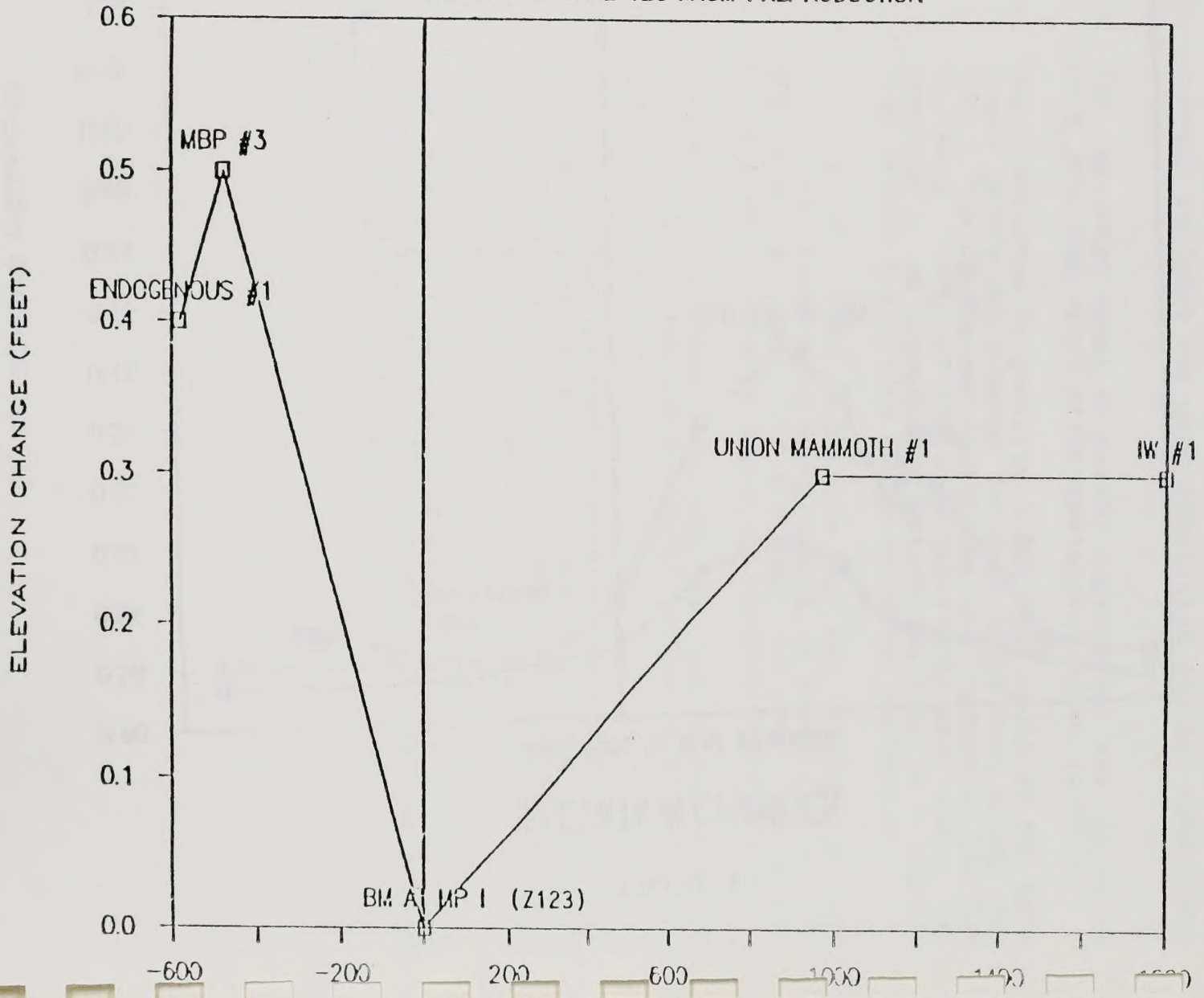


FIGURE 2

MP I WELL ELEVATION CHANGES

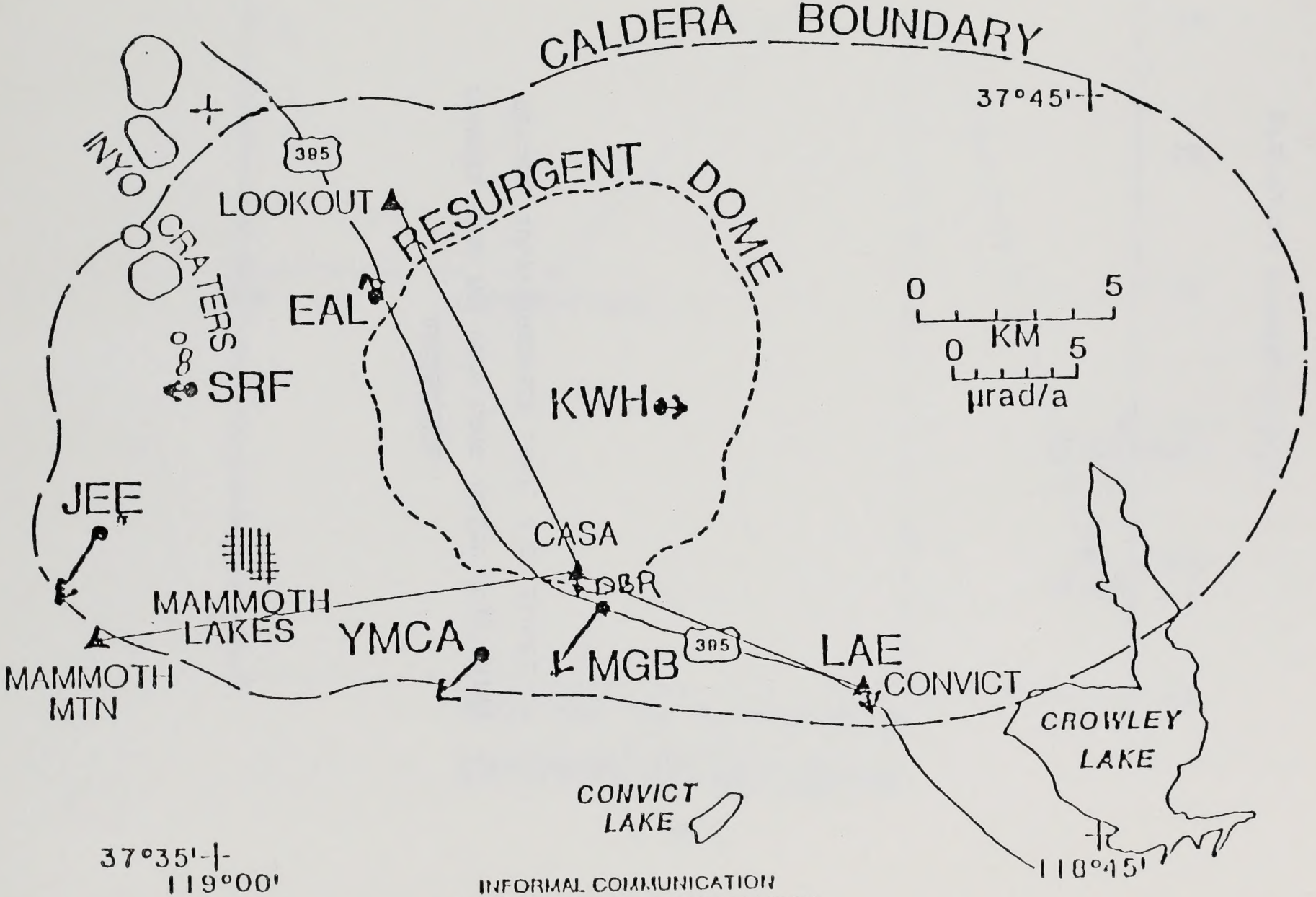
RELATIVE TO BM Z 123 FROM PREPRODUCTION



APPENDIX A

FIGURES FROM THE USGS LONG VALLEY MONITORING REPORT, JULY-SEPTEMBER 1987, J.S. SAVAGE

FIGURE G10: Map showing infra-red geodimeter lines and L-shaped level figures. Arrows indicate the direction and magnitude (see scale in urad) of cumulative tilts measured at each array for the interval 83.7 (Sept. 1983) to 87.6 (Aug 1987).



INFORMAL COMMUNICATION
NOT TO BE CITED FOR PUBLICATION

10-140

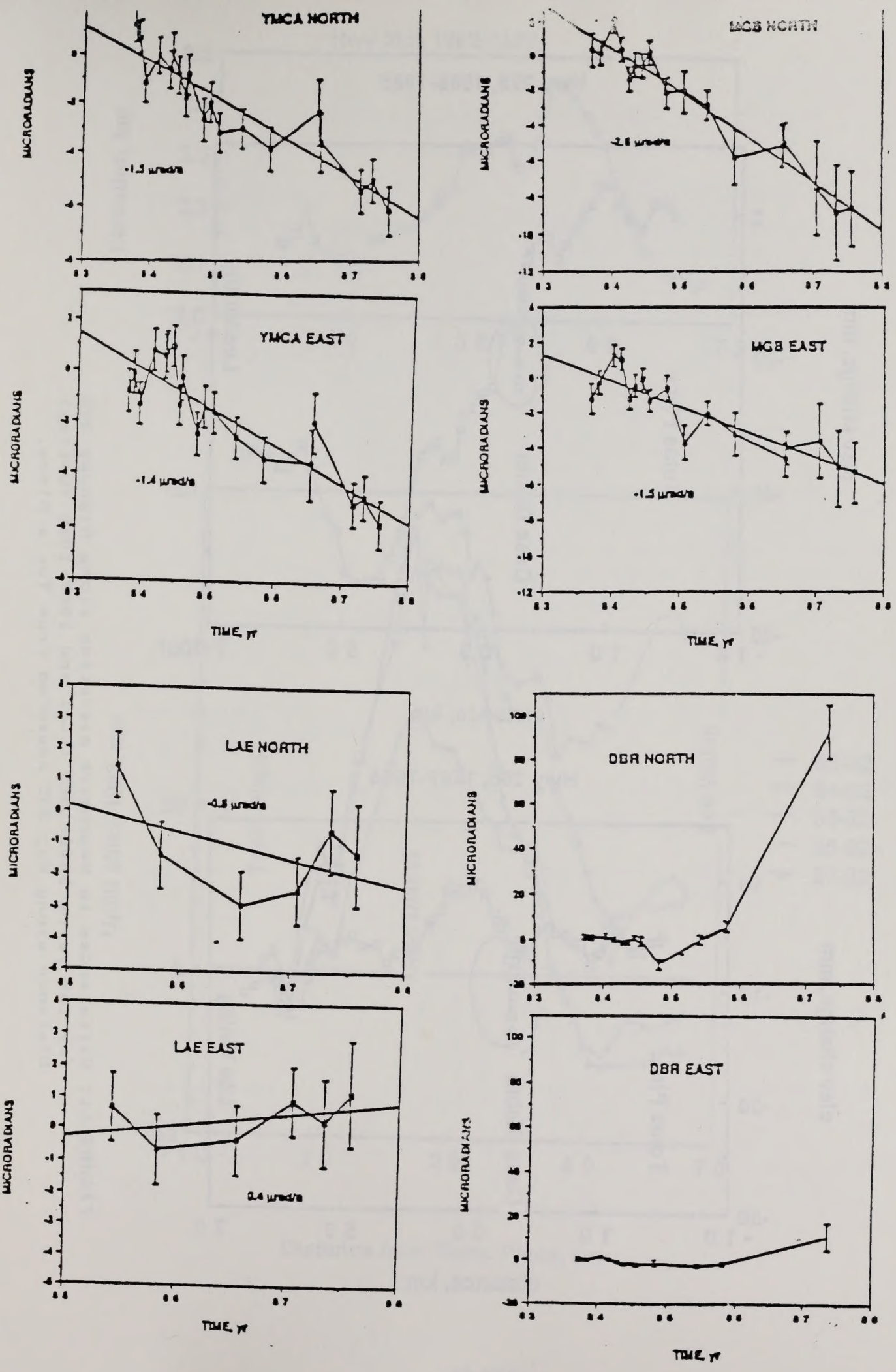


FIGURE G-12 cont'd

INFORMAL COMMUNICATION
NOT TO BE CITED FOR PUBLICATION

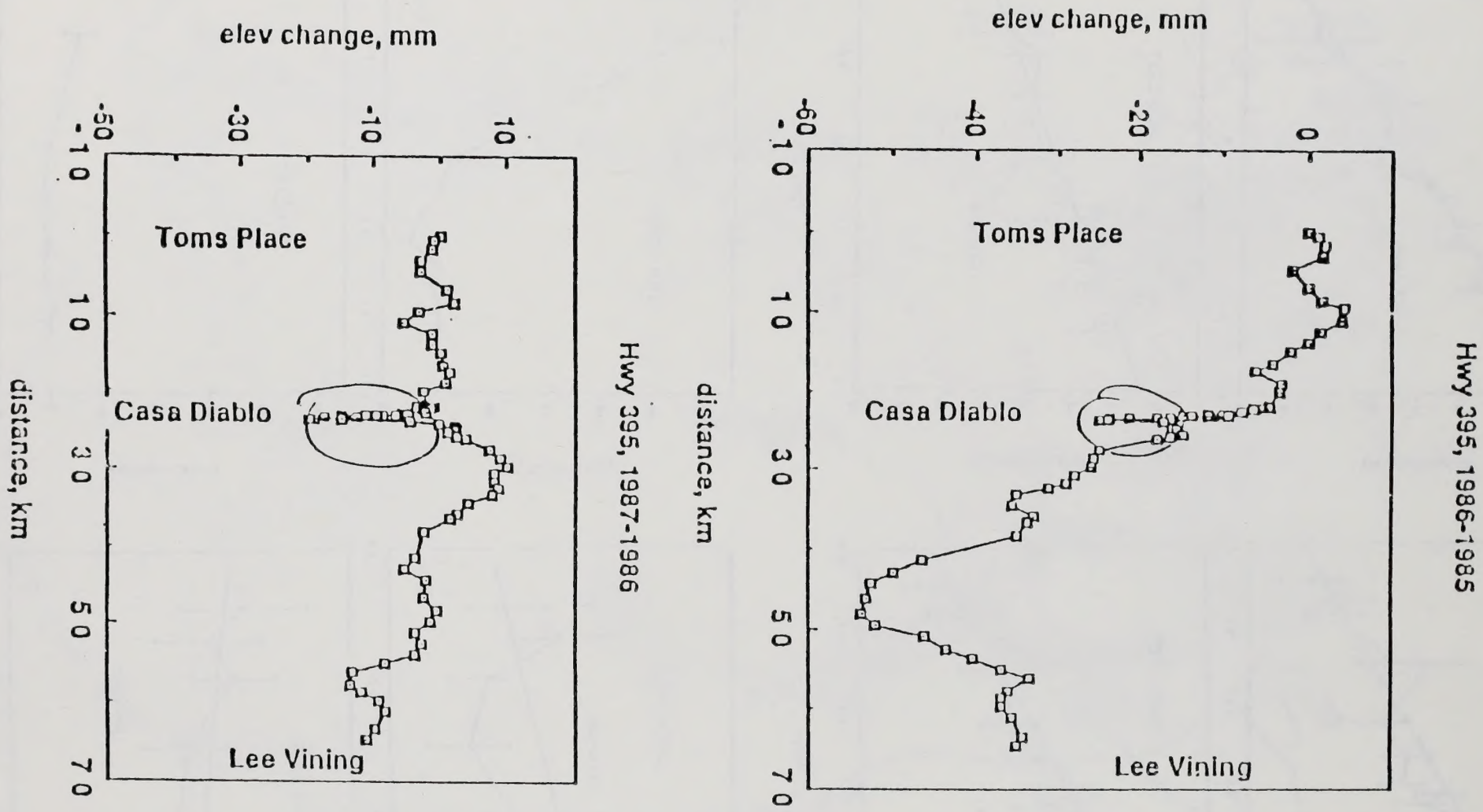


FIGURE L1: Differences in benchmark elevation along Highway 395 for the years 1986-1985 (top) and 1987-1986 (bottom). Distance along Hwy 395 measured from Tom's Place.

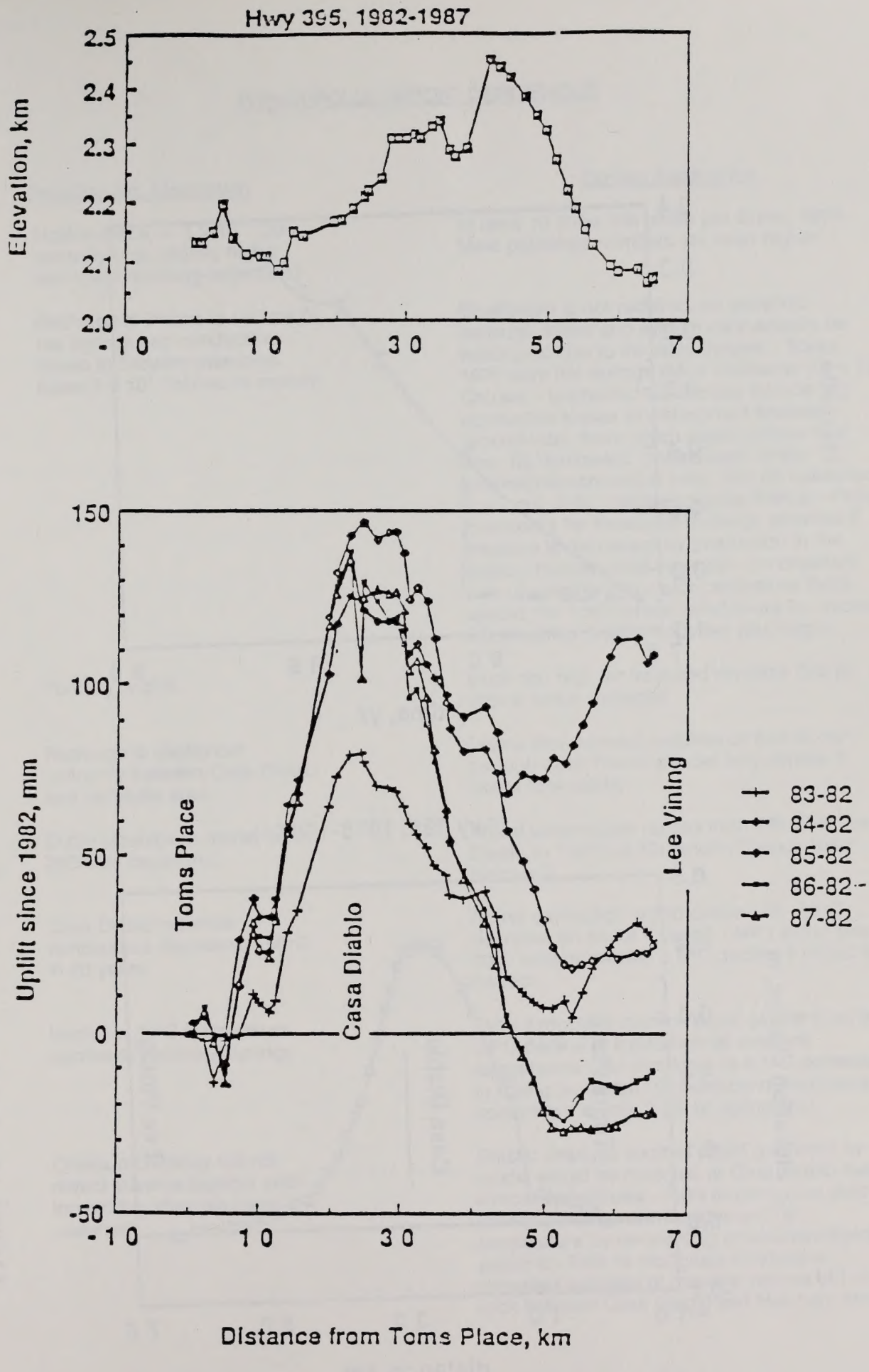


FIGURE L2: Differences in benchmark elevation along Highway 395 for the years 1982-1987 (top) and 1983 through 1987 with respect to 1982 (bottom).

L 2

FIGURE L3: Results of principal mode analysis of leveling data along Hwy 395 for 1975 through 1987. The dashed line in the temporal variation (top) represents the possibility that the onset of resurgent dome uplift coincided with the May 1980 Mammoth Lakes earthquake sequence.

PAPADOPOLUS REPORT DEFICIENCIES

	Papadopulos Assumption	Correct Assumption
1.	Heat-in-Place, = 1×10^{17} Cal (actually uses slightly higher and lower numbers in models)	At least 10 times this much per Sorey, 1988 - Most published numbers are even higher
2.	Recharge is limited to outflow of hot springs and conductive losses in Crowley meadows (Uses 5×10^{7} Cal/sec in model)	Equilibrium is not required, as meteoric recharge varies and system may actually be heating-up due to intrusive magma - Sorey, 1976 says hot springs alone discharge 6.9×10^{7} Cal/sec - uncredited discharges include: (1) conductive losses to widespread shallow groundwater flows which mask surface heat flow; (2) downward "cooled legs" of the geothermal convection cells; and (3) subsurface flows out of the caldera towards Bishop - Fails to account for increased recharge potential if pressure is decreased by production in the shallow hydrothermal reservoir - Inconsistent with observations in major geothermal fields around the world where withdrawals far exceed the identified pre-development discharges
3.	Porosity is 35%	Much too high for fractured rhyolites (5% to 10% is better estimate)
4.	Recharge is distributed uniformly between Casa Diablo and Hatchery area	Lateral flow concept requires all flow to go through Casa Diablo (model only applies if lateral flow exists)
5.	Entire reservoir in model is 200°C at beginning	Actual temperature ranges from 175°C at Casa Diablo to 130°C at Mammoth/Chance (near Hatchery)
6.	Casa Diablo reservoir temperature decreases 150°C in 20 years	Power generation would cease with ±30°C decrease (in about 4 years) - MP I alone should have already caused a 6°C decline if model is correct
7.	Implies a 34°C temperature decline at Hatchery Springs	Even if model is correct "as is" (which it isn't), a 34°C decline in hydrothermal reservoir temperature only translates to a 1°C decrease in spring temperatures because hydrothermal component is only 2-3% of spring flow
8.	Claims monitoring will not detect adverse impacts until irreversible changes have occurred	Drastic changes such as those predicted by model would be detected at Casa Diablo itself almost immediately - Fails to recognize ability to control pressure distributions and/or temperature by re-orienting production/injection patterns - Fails to recognize conductive reheating potential of massive volume of hot rock between Casa Diablo and Hatchery area.

S1104881.603

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta GA 30333

October 21, 1988

Area Manager
Bishop Resource Area
787 North Main Street, Suite P
Bishop, California 93514

Dear Sir:

In accordance with the National Environmental Policy Act, we have reviewed the Draft Environmental Impact Statement (EIS) for the "PLES I Geothermal Development Project, Mono County, California" which you provided to us. We are responding on behalf of the U.S. Public Health Service.

We wish to emphasize the need for compliance with the requirements of the Occupational Safety and Health Administration for worker safety both during the construction phase and in the actual power plant operation. In our review of the proposed Geothermal Development Project, we found potential hazards to public health posed by this project, in general, to be well defined and mitigated. However, we believe that additional attention should be devoted to
9-1 the potential health threat due to the quality of indoor air in the power plant.

Although neither the geothermal fluid nor the isobutane working fluid, to be used in the shell-and-tube heat exchangers, would be exposed to ambient air under the proposed engineering design, we believe the area within the power plant should be monitored for levels of Hydrogen Sulfide, hydrocarbons, and radon gas. Radon can be found in high concentrations in soils and rocks
9-2 containing granite, uranium, shale, phosphate, and pitchblende. While radon levels would not be of concern in outdoor air in the area of the wells and power plant, the area inside the power plant could be subjected to increased levels of radon. You may choose to have the geothermal fluid tested for radon levels to negate the necessity for testing for radon levels in the air inside the power plant.

Please insure that we are included on your mailing list for the FEIS for this project as well as other documents which are developed in accordance with the National Environmental Policy Act.

Sincerely yours,

David E. Clapp, Ph.D., P.E., CIH
Environmental Health Scientist
Special Programs Group
Center for Environmental Health
and Injury Control

THE TOWN OF MAMMOTH LAKES CALIFORNIA

PLANNING DEPARTMENT

P.O. Box 1609, Mammoth Lakes, California 93546
619-934-8983

October 6, 1988

Area Manager,
Bishop Resource Area
787 N. Main Street, Suite P.
Bishop, Ca. 93514

Dear Mr. Morrison,

Thank you for allowing the Town of Mammoth Lakes the opportunity to comment on the Draft EIS for the PLES I geothermal plant. As you know, we were concerned over potentially significant adverse impacts of the plant and we commend your decision to prepare an EIS.

Our comments on the DEIS are:

10-1 1. The alternate location considered by the DEIS provides significantly better visual screening than the primary location. The Town feels that this location is preferable. However, we do believe that additional mitigation is required including burial of fluid transmission pipelines to reduce conflicts with mule deer migration.

10-2 2. If this project is approved, there should be a time period established to monitor the effects of the two operating plants before any more plants are considered in the vicinity. The Town feels that a five year span between power plant installation would be appropriate.

10-3 3. Because this plant will reduce habitat within the mule deer migration corridor, the applicant should be required to purchase other developable property within the migration corridor or winter range and donate it to the BLM or Forest Service for protection of critical habitat.

10-4 4. The procedures for monitoring the impacts to the geothermal reservoir should be modified to assure more independence. We would like to see wider participation

in the Long Valley Hydrological Advisory Committee and we feel that the data should be collected by an independent party responsible directly to the BLM or the HAC, not the applicant.

5. Page 1-9, section 1.4.1.4 Visual Resources. The concern of the Town is not just on the detrimental effects on tourism. We are also concerned with how a deterioration in the visual environment affects residents. This should be addressed as well. 10-5

6. Page 3-36, Figure 3-5. This map should be extended to the west to cover the lands which could be affected by the alternate plant location. 10-6

7. Page 4-34, section 4.1.4.2.1 Proposed Project Impacts. If the cold water well lowers local groundwater levels, would that have an impact on the ephemeral ponds to the west? If so, how could that be mitigated? This question should be addressed in the final EIS. 10-7

8. Page 4-68, Deer Migration Mitigation Alternative Location. This section does not discuss options such as burying fluid transmission lines. Burial should be discussed and if it is a successful mitigation, it should be required. 10-8

9. Section 4.3.6, Proposed Project Impacts. The only analysis is from the point where 395 crosses Mammoth Creek. While this is a sensitive vantage point, using it as the sole viewpoint oversimplifies the visual impacts. The project location is much more exposed from the vicinity of the intersection of 203 and 395. Mitigation such as tree transplanting would have less immediate effect, would require more trees, and would take longer to achieve the visual quality objectives than the analysis indicates. Further, while transplanting appears to offer an exceptionally effective means of providing screening, it has been attempted only recently and on a limited scale in the project vicinity There has not been sufficient time to determine survivability of the transplanted trees. 10-9

10. Page 4-104, mitigation. The Mammoth Unified School District eliminated developer impact fees about six months ago so this measure no longer is applicable. 10-10

11. If the proposed mitigation measures for the alternate plant location are inadequate to prevent significant 10-11

adverse impacts to the mule deer herds, we would no longer feel that that site is preferable.

10-12 12. If the project is to be approved, all proposed mitigation measures should be required.

Sincerely,

Gary Flynn,
Mayor

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF TRANSPORTATION
500 SOUTH MAIN STREET
P.O. BOX 847
BISHOP, CA 93514

October 14, 1988

File: Mno-395-R25.75
SCH #86122913

Bishop Resource Area
787 No. Main St., Suite P
Bishop, CA 93514

Attn: Area Manager

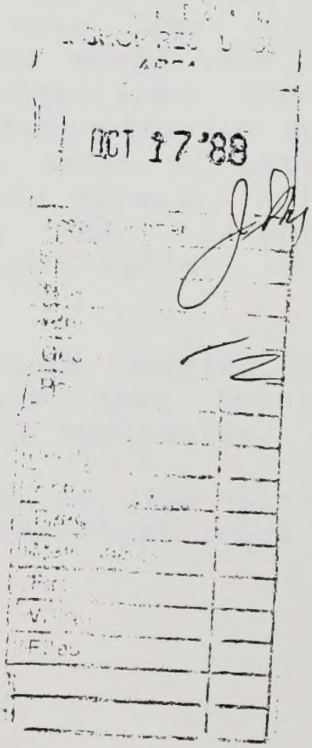
EIS/EIRS for PLES 1 Geothermal Project, SCH #86122913

11-1 We have reviewed the above-referenced document and find that it addresses our concern adequately.

Very truly yours,

Andrew J. Zeilman, Chief
Transportation Planning Branch

AJZ:ac



United States Department of the Interior

FISH AND WILDLIFE SERVICE
SACRAMENTO ENDANGERED SPECIES OFFICE
2800 Cottage Way, Room E-1823
Sacramento, California 95825

OCT 21 1988

In Reply Refer To:
EML/1-1-88-I-44

MEMORANDUM

To: Area Manager, Bishop Resource Area, Bureau of Land Management, 787 N. Main Street, Suite P, Bishop, California 93514

From: Acting Field Supervisor, Endangered Species, Fish and Wildlife Service, Sacramento, California

Subject: Draft Environmental Impact Statement/Environmental Impact Report for the Proposed PLES I Geothermal Project, Mono County, California

This memorandum responds to your September, 1988, request for comments on the subject document. Our comments are limited in scope and address only the potential impacts the project may have on the endangered Owens tui chub. We previously consulted with the Bureau, pursuant to Section 7 of the Endangered Species Act, on this project, and also provided comments in response to the notice of preparation of a draft Environmental Impact Statement. (See our July 22, 1988, memorandum in which we outlined the conditions under which reinitiation of formal consultation should be considered.)

The California Department of Fish and Game recently forwarded us a copy of the technical input it received from its consulting hydrologist regarding potential impacts to the Hot Creek headsprings. (See enclosed copy of the October 7, 1988, letter from S. S. Papadopulos & Associates to the Department of Fish and Game.) The Department's technical consultant concluded: (1) geothermal development will create thermal pits within the geothermal system surrounding the Casa Diablo area, (2) that these geothermal pits will ultimately migrate to areas of natural thermal discharge, and (3) that the temperatures or heat flux of the natural discharges will be reduced.

12-1

We request that you address these comments and conclusions in the final Environmental Impact Statement, and that you determine whether the criteria in 50 CFR 402.16(b) have been met relative to the reinitiation of formal consultation because of the presentation of new information.

Please contact Ed Lorentzen or me at (916) 978-4866 if you have any questions regarding our comments.

David L. Harlow

Enclosure

cc: Chief, Endangered Species, Portland, OR (FWE-SE; Attn: Ralph Swanson)
Field Supervisor, Laguna Niguel Field Office, Laguna Niguel, CA (Attn: Patricia Rice)
California State Director, Bureau of Land Management, 2800 Cottage Way, Room E-2841, Sacramento, CA 95825
Regional Forester, Pacific-Southwest Region U.S. Forest Service, 630 Sansome Street, San Francisco, CA 94111
Director, California Department of Fish and Game, 1416 Ninth Street, Sacramento, CA 95814 (Attn: Larry Eng)
Fisheries Manager, California Department of Fish and Game, 407 W. Line Street, Bishop, CA 93514 (Attn: E.P. Pister)

S. S. PAPADOPULOS & ASSOCIATES, INC.
CONSULTING GROUND-WATER HYDROLOGISTS

S. S. PAPADOPULOS
S. P. LARSON
C. B. ANDREWS
T. J. DURBIN

October 7, 1988

Mr. Curtis Milliron
California Department of Fish and Game
407 W. Line Street
Bishop, California 93514

Dear Curtis:

I have reviewed the draft Environmental Impact Statement on the PLES I geothermal project in the Mammoth Lakes area, and I have the following general and specific comments:

General Comments

Important environmental issues regarding the proposed project are (1) the individual impacts of the PLES I project on spring discharges and (2) the cumulative impacts of the PLES I project together with other projects on those discharges. The principal springs at issue include the springs in the Hot Creek gorge area and the springs in the fish hatchery area. The PLES I project and other existing and proposed projects will have a significant adverse impact on the thermal component of spring discharges, but an adequate evaluation has not been made of the impacts.

12-2

The projects will "mine" heat from the natural geothermal system in order to produce electrical power. The cumulative rate of heat production, or rate of mining, for the existing and

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proposed projects will be about 1.5×10^8 calories per second. Over the planned 30-year life of the projects, a total of 1.4×10^{17} calories of heat will be removed. This will result in the cooling of part of the geothermal system. In the affected areas, the temperature within the geothermal system will be reduced by as much as 100°C. The affected volume of the geothermal system will be 2.6×10^9 cubic meters. If the assumption is made that the system is 150 meters or 500 feet in thickness, the affected surface area will be 170 square kilometers or 7 square miles. Therefore, the mining of heat will create thermal "pits" within the geothermal system that have a depth of 500 ft and a cumulative surface area of 7 square miles. These pits are analogous to the excavations of open-pit mines. However, in the case of geothermal development, heat is excavated instead of mineral ore.

The cumulative volume of the thermal pits is independent of whether the source of the mined heat is stored heat or replenished heat. As a more general statement, it is also independent of the conceptual model that applies to the geothermal system. This can be understood from the following analogy: Imagine a barrel that has been filled with water to overflowing from a garden hose. Now, consider the first of two situations. The tap is still on, and water is overflowing from the barrel. Then, a bucket is dipped into the barrel, and a bucket-full of water is removed.

However, these thermal pits will not remain stationary. They will be swept from the project area, toward the southeast, to the vicinity of Hot Creek gorge and the fish hatchery springs. The pits will migrate because they will move with the water that flows within the geothermal system. Data are not available to determine the rate of migration. However, based upon reasonable assumptions regarding the possible ranges of the determining factors, the pits probably will migrate at a rate between 50 to 500 meters per year. These rates translate into travel times of 80 and 8 years. Regardless of the rate of migration, however, the pits eventually will reach the Hot Creek gorge and the fish hatchery springs.

The mining of heat from the geothermal system will create a heat deficit in that system. That deficit ultimately will be manifested in part as decreased temperatures in the thermal component of the spring discharges. The heat deficit might be thought of as a "pollutant" within the natural geothermal system. The mining of heat by the projects will introduce the pollutants into the system. After project operations have been terminated, the pollutants will remain within the system, until they are discharged from the geothermal system in the areas of natural thermal discharge, where the discharges include the convective heat flow from springs and conductive heat flow to the land surface.

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The draft EIR neither acknowledges this ultimate outcome nor attempts to analyze it in any meaningful manner. Crude models have been developed in order to predict the impacts of geothermal development on Hot Creek gorge and the fish hatchery springs. However, these models do not represent the essential elements of the geothermal system with regard to the response of the system to development. The most important element is that the development and migration of the thermal pits is a transport phenomenon, and at least the migration of the pits must be treated explicitly as such in any model that is proposed as a tool for predicting the impact of geothermal development. A second element is that the relevant transport processes occur within a particular hydrogeologic environment, and the model must incorporate information about the local properties of the hydrogeologic system. The existing models that were used in the preparation of the EIR incorporate neither of these essential elements.

The EIR is flawed both in the methods that are used and in the conclusions that are reached, and it should be rejected as a statement of the impact of development on the geothermal system. From consideration of just the most basic physical laws of the conservation of mass and the conservation of energy, the only possible conclusions regarding the impacts are (1) that geothermal

development will create thermal pits within the geothermal system, (2) that pits will ultimately migrate to areas of natural thermal discharge, and (3) that the temperatures or heat flux of the natural discharges will be reduced. These conclusions hold regardless of the conceptual model that is applied to the geothermal system. The issues represented by these conclusions are not addressed in the EIR.

Specific Comments

Page 4-36. Paragraph 2.

The design of a viable monitoring program demands that the phenomenon to be monitored be properly considered. Owing to reinjection, significant pressure changes will not occur within the regional geothermal system. However, reinjection of colder water will create the thermal pits that were described above. Once the pits are created, they cannot be removed in any practical manner. The pits will migrate within the regional geothermal system. Then, especially if the rate of migration is slow, all that a monitoring program will do is to track the inevitable migration of the pits to the areas of natural thermal discharge.

12-3

Page 3-40. Paragraph 3.

Considering the cumulative impact of the PLES I project together with other existing and proposed projects, the projects will produce thermal pits with a surface area of 7 square miles.

12-4 This value is calculated by assuming a rock-water heat capacity of 5.5×10^5 calories per cubic meter, a thickness of 150 meters, a temperature differential of 100°C, and a cumulative production over 30 years of 1.4×10^{17} calories. The conclusion is that the projects cumulatively will create very significant thermal pits within the natural geothermal system.

Page 4-41. Paragraph 1.

The migration of the thermal pits to Hot Creek gorge or to the fish hatchery springs does not require an "extremely abnormal" flow pattern. It simply requires the consideration of alternative flow

12-5 patterns. Nevertheless, the important fact is that the thermal pits inevitably will migrate to the areas of natural thermal discharge. That outcome holds regardless of the conceptual model or flow patterns that apply to the actual system, and that outcome should not be in dispute.

Page 4-41. Paragraphs 3 and 4.

Little is known about the large-scale bulk permeability of the geothermal system. Accordingly, statements about fluid velocities are merely speculations. The actual velocities easily could be an order of magnitude higher than stated, and the travel times concomitantly could be an order of magnitude shorter. Regardless of the fluid velocity, the thermal pits will inevitably migrate to the areas of natural thermal discharge. Furthermore, impacts will always be impacts regardless of the time at which they occur.

12-6

Page 4-43. Paragraph 2.

The fact that impacts have not yet occurred is absolutely no evidence that impacts will not occur at some future time. The model calculations are no evidence that impacts will not occur, because the models do not represent the essential features of the geothermal system.

12-7

Models can be valuable tools for the assessment of the impacts of development on the geothermal system. However, models easily can be misused by accident or for other reasons. Models are nothing more than a formal statement of the modeler's assumptions regarding a specified system. If the modeler's underlying concepts

of how the system behaves are incorrect or overly simplified, then the predictions that are made using the model will be incorrect. The art of model building is to identify the essential elements of the system and to incorporate those elements into the model. However, the models that were used in the development of the EIR are based on an overly simplified conceptualization of the system, do not incorporate the essential elements of the geothermal system, and are therefore not valid predictors of the response of the system to development.

Appendix C. Page 32. Paragraph 3.

The pressure-response and bulk models probably provide a reasonable gross assessment of the pressure effects within the geothermal system and of the initial development of the thermal "pits" within the vicinity of reinjection wells. The heat-balance model can only provide qualitative indications of the direction of long-term regional impacts, and it cannot produce quantitative predictions of the magnitude of the impacts. The problem with the heat-balance model is that it does not sufficiently represent the essential features of the actual geothermal system. Additionally, certain parameter values of the model (such as the reservoir volume) are difficult to assign properly, and the quantative predictions are sensitive to the selected values. To assess the

12-8

long-term regional impacts, a more physically based model would be required.

Appendix C. Page 45. Paragraph 2.

12-9 The block sizes that are used in the heat-balance model should be selected to encompass just the area over which temperature changes will occur. Likewise, the blocks should not include areas in which temperature changes do not occur. The block sizes used in the Papadopulos model assume that temperature declines will spread laterally over a width of about 1300 meters. The heat-balance model that is described in Appendix C implicitly assumes that temperature declines will spread laterally over a width of 3700 meters. However, calculations in Appendix C using the bulk model state that the thermal front would spread laterally 800 meters. Therefore, the heat-balance model that is described in Appendix C is inconsistent with the bulk model. However, the Papadopulos model is more consistent, but an even smaller reservoir volume might have been used in the Papadopulos model.

Appendix C. Page 46. Paragraph 1.

12-10 Given the actual magnitude of the resource and the environmental constraints on its development, the combination of the existing and proposed projects taken together represent an

unreasonable expection regarding the magnitude of possible development. The projects taken individually and in aggregate represent a significant risk to the environment and perhaps a significant risk in terms of the economic viability of the projects.

Appendix C. Page 47. Paragraph 1.

The results obtained with the heat-balance model that is described in Appendix C do not indicate what actually might occur within the geothermal system. The arbitrary use of a reservoir
2-11 volume that is much too large results in computed temperature declines that are much too small. As discussed above, the block widths should be equal to the width that will be effected by temperature declines. That width is significantly smaller than that used in the heat-budget model that is described in Appendix C. Accordingly, the simulation results are meaningless regarding the magnitude of impacts.

Summary Remarks

-12 Much has been made in the EIR and elsewhere of the controversy regarding the conceptual model that applies to the geothermal system. However, that controversy has little relevance to the

larger picture, because the general impacts of the projects will occur regardless of which of the "lateral flow" or "upwelling" models properly describes the actual system. Most of the remarks that have been made above are not based on any particular conceptual model. Regardless of which conceptual model applies, the project will impact the areas of natural thermal discharge. The only relevance of the conceptual model to a discussion of impacts is with regard to the temporal and spatial distributions of those impacts. Nevertheless, the total "mass" of the impact is independent of the conceptual model.

Sincerely,
S. S. PAPADOPULOS
AND ASSOCIATES, INC.

Timothy J. Durbin

Timothy J. Durbin
Vice President

UNITED STATES GEOLOGICAL SURVEY

WATER RESOURCES DIVISION
P.O. BOX 1298
SANTA ROSA, CALIFORNIA

JAN 26 1989

Nov. 8, 1988

Area Manager
Bishop Resource Area
787 N. Main St.
Bishop, California, 93514

Dear Area Manager:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement for PLES I Geothermal Project, September 1988. In general the document is well written and comprehensive, however I have noted a few errors of fact, a few points in need of clarification, and a few points of discussion that should be included.

Errors Noted:

13-1 1. Pages 2-33 and 2-34 are missing and pages 3-24 and 3-23 are found in their place. Of course this prevents anyone from commenting on what may be discussed on those pages.

13-2 2. Page 3-38, Fish Hatchery spring H-I is described as "the lowest temperature spring in the cold water source area to the west." This sentence is confusing because spring H-2,3 is colder than spring H-I.

13-3 3. Page 3-28, section E, second sentence, "seasonal spring temperatures have varied from 73° to 94° C during a 1983 to 1985 monitoring period at HC-1 and HC-2 springs." This sentence implies a seasonal 21° temperature variation for these springs. That is not correct. The flow rates of many springs diminish over time as mineral precipitation clogs the supply conduits. As the flow diminishes, the water temperature also diminishes due to greater conductive losses. However many springs in Hot Creek gorge remain vigorous for years and their temperatures vary by 1-2° C over the seasons at most. One spring in the gorge has been within 2° C of 92° C between 1983-1988.

13-4 4. Page 3-31, paragraph 1, last sentence states the elevation of the high temperature zone is approximately 400 ft. lower at Shady Rest than at Casa Diablo. The difference is only 100ft, 6700 ft. at Shady Rest and 6800 ft. at Casa Diablo.

Points in need of clarification:

13-5 1. Setmire, J.G., 1984 is referenced on pages 3-26 and 4-27, claiming his report showed the discharge of thermal water from the Casa Diablo wells during 1962 had no adverse impact to Mammoth Creek. His report was written 22 years later and was never intended to address this issue. His report makes no assessment of the impact from well discharges.

13-6 2. Page 3-26, paragraph 3, mentions 760 gpm from Casa Diablo wells was directed to the creeks. However, this was 760 gpm at the well head, much less flow would have reached Mammoth Creek due to infiltration and evaporation.

13-7 3. Page 3-32, last paragraph, isotopic analyses arediscussed. The point is made that large differences in isotopic ratios in different springs and wells can be interpreted under the "Lateral Flow Model" as caused by complicated processes of mixing, boiling, and different recharge areas. Then it is suggested that the "Upwelling/Fracture Flow Model" provides a less complicated explanation of the isotope data. Table 1-4, appendix C shows δ D in springs at Casa Diablo varies from -110.9 to -122 and δD in wells varies from -111 to -117 (not including the flashed sample from IW-2 on 1-7-84). The source of water for the springs at Casa Diablo is the same as for the wells at Casa Diablo regardless of which model, Upwelling or Lateral Flow, is correct. The fact that differences do exist between springs and wells at Casa Diablo shows isotopic ratios do vary due to evaporation, boiling, mixing, and other processes and that the differences do not require different source reservoirs as claimed in the Upwelling Model.

13-8 4. Page 4-34, paragraph 4.1.4.2.1, it is stated that "neither the alluvium nor a significant shallow fresh water resource is continuous downslope toward Chance Ranch...". This claim is not substantiated and actually there is a high likelihood that the shallow fresh water aquifer is continuous to the south and east of Casa Diablo toward Chance Ranch.

13-9 No analysis is given for the cumulative impact of supplying irrigation water for all the projects MP I, II, III, PLES-I, and Mammoth/Chance.

Needed additions:

13-10 1. Page 4-29 and 4-32, discusses temperature impact to Mammoth Creek if a pipeline ruptured. Scenarios are presented separately for pipeline breaks at the PLES-I and MP-I well fields, but no cumulative impact analysis is given for pipeline breaks at two or more project sites. All proposed project sites are located on or near faults and the area is known for its frequent seismic events. It is conceivable that fault displacement could cause pipeline breaks at more than one project site at the same time, therefore the cumulative impact should be addressed.

13-11 2. No assessment is provided for the impact to Mammoth Creek water quality from potential pipeline breaks. The discussion on page 4-29 is inadequate and uses the reference, Setmire (1984), incorrectly to suggest

13-11 no impact was detected to water quality in 1962. An analysis of water quality impact should be included considering the potential cumulative impact from several projects if the containment ponds overflow or fail. This analysis could follow what is given for the temperature impact but should include the cumulative impact of more than one project.

General comment:

13-12 Several numerical models have been used to predict future conditions under various production scenarios. The results of these predictive models provide a wide range of potential outcomes. Numerical models can not provide meaningful projections of future conditions when they are based on sketchy hypotheses. When considerable data are available numerical models can be more strictly constrained and may provide worthwhile predictions. The widely divergent predictions that are forecast by various modellers using various modelling approaches demonstrates a lack of data at the present to adequately constrain the models. All the models presented thus far are not well constrained and their relation to the real world is very tenuous at best. The results predicted by these models are equally unreliable and should be considered only as possible examples of what might happen if everything included in the models are correct.

However, numerical models are not required to adequately assess all the possible adverse impacts caused by developments. Reasonable cautionary measures can be a part of development and continuous monitoring of key points in the hydrologic system can insure early detection of potential problems and provide needed data to decide what modifications in development operations can reverse an adverse trend.

Sincerely,

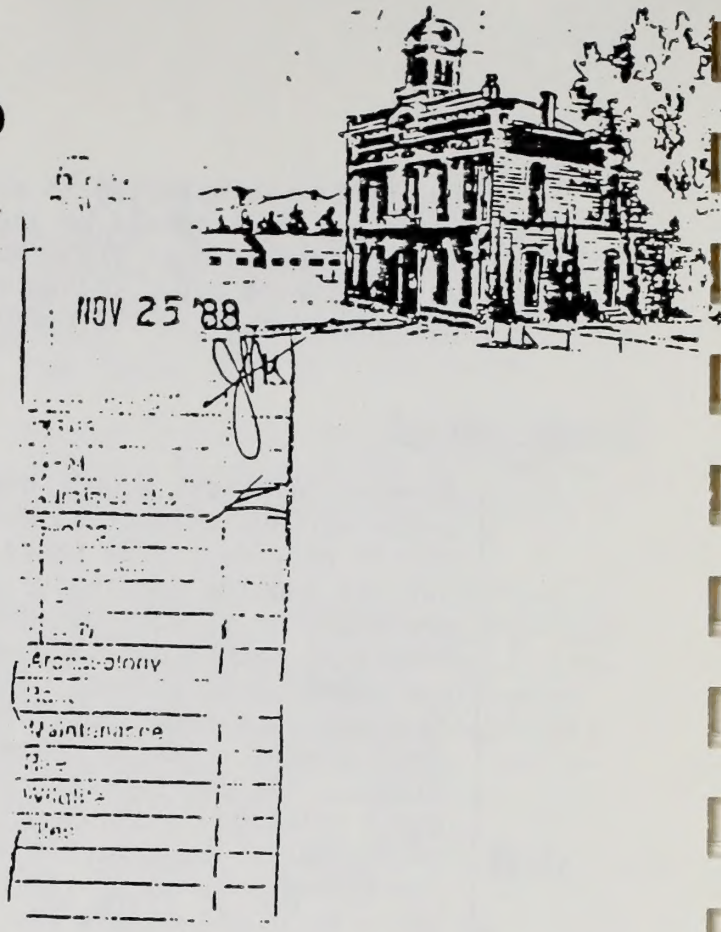
Christopher D. Farrar

COUNTY of MONO

ENERGY MANAGEMENT DEPARTMENT

HCR 79, Box 221
Mammoth Lakes, CA 93546
(619) 934-6704, Ext. 403

EL L. LYSTER
Director



November 23, 1988

Mr. James Morrison
Area Manager
Bureau of Land Management
Bishop Resource Area
787 North Main, Suite P
Bishop, California 93514

RE: RESERVOIR MONITORING REQUIREMENTS FOR THE PLES-I GEOTHERMAL PROJECT

DearJim:

On November 16, 1988, the Long Valley Hydrologic Advisory Committee, Hydrologic Monitoring Subcommittee met at the U.S.G.S. office in Menlo Park. The purpose of this meeting was to review and discuss results of the recent reservoir interference testing at the Mammoth-Pacific I Geothermal Project and to discuss the technical merits and need for requiring two additional monitoring wells (one in the injection zone and one in the vicinity of Colton Spring) prior to the start of commercial production of the PLES-I project, as recommended in the "PLES-I Draft Environmental Impact Statement". The members of the Hydrologic Monitoring Subcommittee which attended this meeting were as follows:

14-1

U.S. Geological Survey - Mike Sorey, Chris Farrar
California Division of Oil and Gas - Robert Habel
Mono County Energy Management Department - Dan Lyster, Bo Bodvarsson
Bureau of Land Management - Ken Chan

The Long Valley Hydrologic Advisory Committee (LVHAC) continues to strongly support the need for geothermal resource monitoring and endorses the "Proposed and Recommended Hydrologic Monitoring Plan for PLES-I 10MW(e) Binary Power Plant" as outlined in the Environmental Assessment and Environmental Impact Report for the PLES-I project. Accordingly, it was the unanimous decision of all subcommittee members that sufficient technical evaluation of the benefits and need for implementing the two additional monitoring wells prior to the start of production should be conducted before formally including these as mitigation measures in the

context of permit requirements for the PLES-I project. This technical evaluation is expected to be completed in a timely manner and should not impede the permitting or project completion schedule.

The LVHAC recommends that BLM not require completion of an injection zone and/or Colton Spring monitoring well prior to PLES-I commercial production until the LVHAC has determined the scientific basis for, and benefits to be gained by such a permit requirement. It is the intention of the LVHAC to open the technical review process to all LVHAC members wishing to participate, including the California Department of Fish and Game and their consultants.

A formal recommendation from the LVHAC on this issue will be made to your agency subsequent to completion of the technical review and concurrence by LVHAC members. This process should help to establish optimum monitoring requirements based on sound technical and scientific judgement.

If you have any questions regarding this request, please contact me.

Sincerely,

Dan Lyster

Dan Lyster, Chairman
Long Valley Hydrologic Advisory Committee

DLL/sc

cc: Ken Chan - BLM Sacramento
LVHAC Members
Mono County Board of Supervisors

10.3 RESPONSE TO COMMENTS

10.3.1 GENERAL COMMENTS

Comments: 2-3, 2-63b, 2-88b, 6-1b

Response: Worst-case analyses have been conducted as a part of the EIS/EIR. In regards to the potential hydrologic impacts of the project, where it is acknowledged that the available data do not yet provide the ability to definitively determine whether the Lateral Flow Model or the Upwelling Fracture Flow Model is correct (see Section 4.1.4 and Appendix C) the "worst-case" Lateral Flow Model is assumed to be correct, and the hydrologic impact analysis is conducted based upon this assumption. As the EIS/SEIR states, "the predicted impacts would be lowered to insignificance if the actual conditions more closely approximate the Upwelling Fracture Flow Model." See also responses to comments 2-63a (page 10-179); 2-88a (page 10-174); and 6-1a (page 10-175).

Comment: 2-90

Response: None of the leases in Long Valley lies within the designated special category lands identified in the Geothermal Steam Act of 1970, therefore this comment does not apply.

Comment: 2-12a

Response: There are no project impacts identified as significant after mitigation in the Draft EIS/SEIR. A landscape plan, including trenching and burial of pipeline segments, revegetation measures and visual screening, has been adopted since the proposal described in the Joint EA/EIR. Furthermore, deer crossing ramps have been designed, and all stipulations which were placed on the project by the BLM after the EA/EIR was written were adopted as part of the proposed project. In most cases where no mitigation is

recommended, the proponent has adopted effective mitigation measures as part of their proposal. As a result, all these measures included in the project were not identified as "mitigation" measures in the EIR/SEIR, but they nevertheless result in mitigation of all impacts to levels of insignificance. These measures are described in Chapter 2 and are discussed in appropriate impact sections.Table 2-5 is a summary. It is not meant to substitute for the full body of the text and, of necessity, is brief. To understand the many measures which have been included as part of the project and which are not recommended as mitigation measures in the EIS/SEIR, it is necessary to read the project description or the text immediately preceding the mitigation statement in each section.

The specific comments made in Attachment C of the comment letter are addressed in responses to Comments 2-27 through 2-88.

Comments: 2-13a, 2-28, 6-5, 7-1, 7-3, 8-28, 8-30, 10-12

Response: Comment noted.

Comments: 2-13b, 2-76a, 6-37

Response: These comments are not responsive to the document under review. Material submitted before this document was written are not comments regarding this document and, therefore, specific responses are inappropriate. However, all issues raised during scoping meetings have been addressed in this EIS/SEIR.

Comment: 2-29

Response: The appropriate page has been edited to include springs in the Casa Diablo area.

Comment: 2-34

Response: The California Department of Fish and Game has been added to the list of consulting agencies.

Comment: 8-1

Response: The appropriate pages have been corrected to read 1,510 acres.

Comments: 2-30, 2-31, 2-32, 2-33, 2-58, 2-76b, 3-5, 3-35a, 6-39a

Response: 43CFR 3261 specifically authorizes and directs the authorized officer, (in this case the Bishop Resource Area Manager) to carry out the provision of 43CFR3200, Geothermal Resource Operational Orders, lease terms, and to enforce all stipulations placed on the project. This would include monitoring compliance with provisions in the project description to avoid mature trees "whenever possible," to locate fencing and deer crossing ramps in consultation with the California Department of Fish and Game and BLM and Forest Service wildlife biologists, to evaluate the results of the hydrologic monitoring program and implement mitigation measures in consultation with U.S. Geological Survey and other experts, and all other provisions of the project and stipulations placed on the project by the BLM.

The assumption must be made that the authorized officer will carry out these tasks effectively and in good faith in accordance with the regulatory requirements. Specificity is deliberately omitted from some stipulations to allow the authorized officer to respond to situations, such as: abnormal weather conditions; variability of deer migration dates; and timing specific reclamation actions when there is a reasonable expectation of success. Because the mitigation measures listed in Chapter 2 have been specifically incorporated into the project description by the project applicant, they cannot be altered here.

Comments: 6-19, 6-20, 6-21

Response: An abandonment plan is required by the BLM. Stipulation 27 in Chapter 2 is included as part of the project.

43 CFR 3262.4-1 (7)(k) requires the submittal of methods of final abandonment and requires compliance with all applicable lease provisions, GRO Orders, and regulations. These are legal responsibilities born by the applicant. The U.S. Government now holds a lease bond and the licensee must also supply a site facilities bond prior to operation.

Comments: 6-39b, 6-54, 6-55, 6-56, 6-57, 6-58, 6-59

Response: A landscaping plan is part of the proposal and describes specifics of tree planting, painting schemes, pipeline locations, and lighting. The text has been edited to clarify this. The intended flexibility of pipeline location is limited to within a few feet of the location shown on Figure 2-1. See also response to comments 2-35, 2-64, etc, page 10-209.

Comments: 2-12b, 2-36c, 2-81, 2-87, 3-54

Response: The cumulative analysis identifies for the person who is deciding the approval or denial of a specific project what that project's increment of impact is compared with other past and reasonably forseeable projects in the area. However, neither NEPA nor CEQA requires or suggests that a specific project be responsible for mitigation of the impacts of other projects in the cumulative assessment. In the cumulative analysis, it is shown that the impacts of this project would contribute little to the total measure of impacts to each of the resources of all the projects. We agree that a comprehensive, cumulative study for the overall Mammoth area would be beneficial, but such analysis would do little to help understand the impacts of this project, or its relationship to other projects. This project is not exempt from mitigation measures, which are described in Chapter 4.

Comment: 6-17

Response: The two golf courses were considered for all resources except surface water hydrology and induced growth. The two geothermal projects may never be developed and in any case are years from production. The reasons stated on page F-5 clearly explain why the particular projects were excluded from the analysis for some resources. The resources most likely to be impacted by the Town of Mammoth Lakes wells and golf course would be shallow groundwater and induced growth - neither are issues for the Casa Diablo projects.

Comment: 2-88a

Response: Appendix F is a list and description of the projects considered in the cumulative impact analyses. The impact analyses are contained in the body of the Draft EIS/SEIR. Appendix F is not intended to contain the cumulative analyses. In each resource discussion there is an analysis of cumulative impacts using available information from agencies and environmental documents for the projects described in Appendix F.

The discussions are on pages 4-16, 4-19 to 4-20, 4-23, 4-24 to 4-25, 4-32 to 4-33, 4-34 to 4-35, 4-64 to 4-65, 4-68 to 4-69, 4-73 to 4-74, 4-78, 4-84 to 4-87, 4-89 to 4-90, 4-92, 4-93, 4-96 to 4-99, 4-100, 4-103 to 4-104, 4-107, 4-113 to 4-115, 4-118, and 4-120.

Comments: 8-29, 8-31, 8-32, 8-33

Response: The suggested changes have been made.

Comment: 2-44

Response: A copy of GRO Order No. 4 is attached as Appendix G.

Comment: 13-1

Response: We apologize for the missing pages. The error was not widespread, since no other copies have been found with missing pages.

10.3.2 ALTERNATIVES

Comments: 2-10, 6-4

Response: As a result of the original analysis, the proposed action in the EA/EIR was not selected as the BLM's preferred alternative because of its greater visual impacts and only minor advantages with respect to deer habitat. Since the lead agency found it less suitable for development than the presently proposed project, reanalysis in the present EIS/SEIR would not have increased its suitability over the present proposed location. See page 2-1.

Comments: 3-1, 3-13

Response: Plot plans in Chapter 2 for the power plant site show disturbed areas, pipeline routings, and road locations for all alternatives. The disturbed area, including the O/CR building and well pads, was calculated using engineering drawings, which included road widths, supplied by Pacific Energy. The O/CR building is shown in Figure 2-4 as the Control Building and is fully analyzed in all alternatives.

Cut and fill has been balanced on the site of the proposed power plant and would be at the alternative site, so there would be no spoil sites. Detailed grading plans have been done for the proposed project only; however, it is not necessary to perform full engineering studies for all alternatives in order to assess the relative impacts of the alternatives. Complete sets of engineering drawings are not required or necessarily beneficial in EISs or EIRs.

The geology and soils information is included in the Section 3.1.2.5.

Comment: 6-1a

Response: It is unclear from this comment what specific data are incomplete. It is our opinion that the data available at this time are sufficient to make a reasoned choice among alternatives.

Comments: 6-2, 6-11, 6-12, 6-13, 7-13a

Response: NEPA requires sufficient discussion of each alternative so that the relative impacts can be compared. It is not required that full engineering studies be done for all alternatives. For each resource, there is adequate information to compare the alternative location to the proposed project. The alternative may expose the ephemeral ponds along Highway 395 west of the project to spills, where the proposed project would not. The alternative location would require additional geothermal fluid to provide enough energy for transporting the fluid the added distance and elevation to the power plant from the production and injection fluids. The larger power plant and longer pipelines required for the alternative location would disturb more area than would be disturbed by the proposed project. Acreages, lengths of pipeline, and use of geothermal fluids are quantified in the discussion. Vegetation, especially thermal marshes and rhyolite buckwheat and wildlife, especially mule deer, would be affected more by the alternative location than the proposed project. Complete discussions of all these issues are provided in the body of the EIS.

The commentor (6-11) suggests that by saying 10 to 20% more geothermal fluid would be required, the EIS implies an increased impact to the hydrothermal reservoir. The 10 to 20% increase is based on design estimates of transporting the brine additional distance and uphill. The use of "super insulated pipelines" would not reduce the energy necessary to pump the fluid uphill. The impacts associated with this increase are detailed in section 4.1.4.3.2.

References to Section 2.1.7.9 have been corrected to read 2.1.6.9.

Comments: 6-3, 6-7, 6-16, 7-15

Response: The smaller size power plant was included because it was reasonable to expect that it could have reduced impacts. The fact that it would not be financially advantageous to the project sponsor is not enough to disqualify it from consideration. If it were determined that the environmental benefits associated with the smaller alternative justified the financial burden on the applicant, then this alternative could well have been the preferred alternative. The analysis showed little benefit to decreasing the plant size. The proposed alternatives would all vary geothermal production rates to some degree in

response to ambient air temperature. We believe that the impacts from the commentor's proposed alternative would not differ sufficiently from those of the analyzed alternatives to be considered a separate alternative.

Comment: 6-6

Response: The decision to propose three units is based on available equipment. The binary units selected for this project come in 5 MW increments. The existing MP I (nominal 10 MW) plant which consists of two units and generates a net annual average 7MW. In order to supply a net annual average 10MW, three units would be required. Therefore, the next smaller alternative would be similar to the existing MP I plant composed of two 5MW units.

Comments: 6-39c, 7-14

Response: The text on the appropriate pages has been edited.

Comment: 7-19

Response: As stated on page 2-1 of the EIS/SEIR, "using solar generated electricity ... is not being considered because the basic action under consideration by the BLM is the appropriate development of the federal geothermal lease. Any alternative which does not consider the development of the geothermal lease becomes functionally equivalent to the no-action alternative."

10.3.3 PHYSICAL ENVIRONMENT

Air Quality

Comment: 3-17

Response: The appropriate page has been edited.

Comment: 3-18, 3-19

Response: The analysis conservatively assume H_2S concentrations of 8.0 milligrams per liter, based on observed values ranging from 1.6 to 7.5 ppm by weight of fluid from wells at Casa Diablo (see Table 3-6).

Open tanks at short-term well testing:

500 gpm x 10 min/hr x 3.79 l/gal x 8 mg/l x 1kg/10^6 mg = 1.0 kg/hr

Spill of entire production for five minutes:

5,000 gpm x 5 min x 3.79 l/gal x 8 mg/l x 1 kg/10^6 mg = 0.76 kg

Well blowout:

685 gpm x 60 min/hr x 379 l/gal x 8 mg/l x 1 kg/10^6 mg = 1.2 kg/hr

As stated on page 4-6, open tank testing would not violate PEL standards. The reference to nuisance has been removed.

Comment: 6-18

Response: The areas mentioned in the comment are disturbed areas. The statement on page 4-2 is accurate as written.

Comments: 9-1, 9-2

Response: It is unclear what the potential health threat due to indoor air quality would be. The only indoor areas at the PLES I facility would be the control room and maintenance facility. Leaks or spills or geothermal fluid or isobutane could only occur at the power plant or pipelines, all of which are open-air facilities. Isobutane, H_2S, or radon from the geothermal fluid would disperse rapidly and would not accumulate inside buildings.

The wording on the appropriate page has been edited for clarity.

Comment: 8-10

Response: Comment noted. The recommended mitigation measure has been changed to limit speeds to 15 mph, which would still reduce fugitive dust emissions.

Noise

Comments: 2-45, 2-63a, 3-15, 3-28, 3-44

Response: Dispersed recreational use is identified as a noise-sensitive land use in Section 3.1.3.3. People who are driving in a car along Hot Springs Road would not be able to hear the power plant over the noise of the car. Vehicular traffic and the existing power plant would cause louder noises along the road for cyclists, joggers, and walkers than the proposed power plant.

The difficulty in describing the effects of noise on wildlife is mentioned in Section 4.2.2.1. Wildlife continues to use the site now with MP I in operation and will likely continue to adjust to the small increase in continuous long-term noise levels. In the absence of evidence to the contrary, one cannot predict dire consequences to wildlife from noise if the proposed project is constructed. Since the impacts of noise to wildlife are not well documented, designating it as a sensitive receptor serves no purpose - noise standards have not been formulated which are applicable to wildlife.

Stipulation 12 (Section 2.1.1) restricts noise intensive activities during deer migration periods in the spring and fall and the requirements of Geothermal Resources Operational (GRO) Order No. 4 apply throughout all phases of the project - exploration, development, and operation - and are enforced by the authorized officer. These are not listed as mitigations because they are required by the BLM and have been incorporated into the project design. The authorized officer, under the provisions of GRO Order 4, may impose more restrictive criteria than the 65 dB(A) maximum level and may require muffling devices. The project sponsor accepts the conditions as part of the approval process.

The proposed power plant will produce no more noise than the existing power plant. As stated in Section 3.1.3.2, the noise level 0.5 mile distant from it is approximately 40 dBA.

Comment: 3-29

Response: The text has been edited to encourage carpooling or busing of workers as a mitigation for construction traffic.

Comment: 3-30

Response: The authorized officer has the authority to require BACT as appropriate.

Comment: 3-31

Response: Comment noted.

Geology - Geologic Hazards

Comments: 2-41, 3-2, 3-20, 6-22, 6-23, 7-17, 8-11, 8-12

Response: In January 1988, SEA Incorporated completed a geophysical investigation of the proposed power plant site. The results of that investigation were interpreted to indicate the possibility that a fault crossed the plant site. In October 1988, SEA Incorporated completed a second investigation, consisting of borings and trenches, designed to explore the area of the suspected fault. The results of this second investigation were that no fault existed on the site. What was originally interpreted as a fault was in fact an abrupt change in the density of old hot spring deposits which underly the site.

Groundwater was encountered beneath the hot spring deposits in some of the borings and one of the trenches. The water was warm but was not hot enough to produce steam. Groundwater encountered in the vicinity of structure footings is delt with through footing design and adherence to Uniform Building Code requirements for footing drainage systems.

There was never any indication that moving any of the structures off the site or relocating the site would be necessary.

Comments: 2-43, 3-22, 3-23, 3-24

Response: The proposed project already contains a spill containment plan and other measures specifically designed to prevent the impacts or concerns, so no additional mitigation is proposed. The effects of a major volcanic eruption would overwhelm any environmental effects created by the eruption on the project. Designing facilities to function through a nearby volcanic eruption is not feasible.

All facilities would be built to Uniform Building Code criteria for Zone No. 4 areas. This would include more than sufficient strength for structures to withstand ground elevation changes which could occur at the site. GRO No. 4 requires subsidence monuments as a means of detecting ground movements. Reservoir management techniques would be used if significant adverse subsidence attributable to fluid withdrawal were detected.

Comments: 3-21, 7-10

Response: If required, pumping groundwater would be the mitigation. Installation of piezometers is a means of determining if the mitigation is necessary. There is no need to install the piezometers until after the project is built. Mitigation (2), Section 4.1.2.1, would establish groundwater levels before construction.

Groundwater would be pumped if it rose high enough to interfere with the power plant and could not be dewatered by passive means. Please see revised mitigation in Section 4.1.2.1. This would not deprive plants of water at normal depths, but would prevent the groundwater from rising as high as it would without pumping.

Comment: 8-3

Response: The text on the appropriate page has been edited.

Water Quality and Hydrology

Comments: 1-1, 2-24b, 12-12, 13-7

Response: The discussion of water chemistry in the Draft EIS/SEIR was provided as a small component of the attempt to summarize the two major conceptual models of the Long Valley hydrothermal system, i.e., the Lateral Flow model and the Upwelling Fracture Model. It is less detailed than proponents of the two models would have liked, but is believed by the authors to be sufficient because their basic conclusion was that the existing data did not "prove" either model. As a consequence of this conclusion, the authors elected to concentrate their analyses on reasonable worst-case scenarios based on the Lateral Flow model. The text on appropriate pages has been edited to eliminate the apparent bias. See also response to comments 2-14, 2-15, etc., page 10-187.

Comments: 1-2, 6-34b

Response: The authors believe that it should be clear to all readers that the analytical models used are over-simplications of actual hydrologic processes at work in the region. As indicated by the commentor, such processes could include partial or total injection support without cold water breakthrough. The models and calculated results are intended to be consistent with existing data. Any reservoir changes due to lack of sufficient recharge or injection breakthrough would affect the Casa Diablo projects first. These effects, such as pressure or temperature changes, would serve as indicators.

As mentioned in the response to Comment 1-1, there is need to mention the treatment of recharge to the reservoir. Paragraph a) in Section 4.1.4.3.1 describes the assumptions made with respect to modeling recharge and pressure changes. The complete explanation of model limitations is in Appendix C.

It is a common practice in scientific reporting to acknowledge limitations in existing data and corresponding uncertainty in the analysis. This is followed by a description of data which would decrease those inherent uncertianties. Failure to acknowledge potential sources of error would be a breach of proper scientific reporting.

Comment: 1-3

Response: The method suggested by the commentor of calculating the relationship between reservoir pressure and spring flow is innovative and could be pursued as research on an individual spring and well basis. However, the authors feel that there are insufficient reservoir / spring data available to include such an analysis in the Final EIS/SEIR. Such a calculation for each spring could be very misleading, in that multiple sources of error are introduced by basing one method of analysis on the results of another. This is particularly true in the hatchery area because of the complex mixing and boiling processes known to be taking place which vary with each spring. The authors agree that the statement in the DEIS/SEIR regarding a 1 psi pressure change and its effect on static water levels does not translate directly into the effect on springs flow. However, it specifies the magnitude of the impact on the reservoir, which can be converted to effects at the surface when the relationship is better understood. Any further assumptions regarding the precise effects on springs detracts from the effort made to model and quantify potential effects in the reservoir based on the available data.

Comment: 1-4

Response: The reference to "no temperature decline at Casa Diablo" in the Draft EIS/SEIR was made on the basis of static production well temperature profiles and production fluid temperatures. It was meant to apply only to the production reservoir. Of course, a temperature survey of an injection well will show lower (non-static) temperatures, especially opposite zones taking fluid. Consecutive surveys taken in a shut-in injection well show progressive warming, but return to a true static condition could take many months. This cooling of the injection zone is expected, as indicated by the bulk model analysis. Under any reasonable scenario, consequences of injection zone cooling would be felt in Casa Diablo production wells first. For the flowrates considered by the modelling, however, the analysis showed that cooled fluid cannot travel far without being reheated. The appropriate page has been revised to clarify the reference to temperature declines.

Comment: 1-5

Response: Whether a more accurate model is based on low recharge and high reservoir volume or low reservoir volume and high recharge, the heat balance model presented in the Draft EIS/SEIR is still believed by the authors to represent a conservative scenario. In contrast, the authors feel that most of the values Papadopulos assumed were unreasonably low. The calculations in the Draft EIS/SEIR are based on the same rate of recharge as used by Papadopulos, which is very conservative in itself. Reservoir size was increased in the Draft EIS/SEIR model in order to arrive at a more realistic value for heat-in-place, based on well data, while allowing a flow regime (i.e., lateral flow with unlimited hydraulic communication from Shady Rest to Hot Creek Gorge) consistent with the constraints assumed for the other two methods of analysis.

Comment: 1-6

Response: These comments and the letters referenced are now entered in the Final EIS/SEIR.

Comment: 1-7

Response: Injection well survey data indicate much of the fluid is injected in a 100-foot zone, though the injection wells have open intervals of approximately 500 feet. However, the injection fluid is not likely to be confined to the 100-foot injection intervals as it moves away from the wells due to limited lateral continuity of stratigraphic permeability and the proximity of high angle fractures and faults. If such a thin injection zone had been assumed for the bulk model calculations, thermal breakthrough would have been calculated to have occurred in the region of the existing production wells already. This would not have been consistent with present production experience.

The bulk model calculations presented are believed to represent worst-case conditions due to five basic assumptions, i.e.,: 1) injection zone thickness remains constant at 500 feet; 2) uniform lateral flow occurs throughout the region; 3) no density effects allow cooler fluid to sink to greater depths; 4) no dispersion allows cooler fluid to occupy a greater reservoir thickness as distance from the injection well increases; and 5) the assumed porosity (5%) is quite low.

Even if the injection zone thickness were 100 feet, the thermal front would not reach Hot Creek Hatchery.

Comment: 1-8

Response: The missing information has been added to the appropriate page. The authors agree that the data available for use in assembling any current model are minimal from outside the Casa Diablo area. For both the hatchery and Hot Creek Gorge areas to be included in the Lateral Flow model, a continuous reservoir must be assumed. The result is an overall heat-in-place of 10×10^{17} cal. The authors believe it would be even more difficult to justify smaller blocks (i.e., Numbers 2, 3, 4) east of Casa Diablo to allow a sinuous path of lateral flow which includes the hatchery and the gorge areas. The authors contend that if consideration of a region the size of the blocks modeled is unwarranted, then there is little likelihood that areas included in them, such as the hatchery and gorge, will be affected.

Comment: 2-2

Response: The commentor's contention that "a significant and unmitigatable impact to the Hot Creek spring system is to be expected" is based on the initial report prepared by S.S. Papadopulos & Associates, Inc. (Papadopulos) for the California Department of Fish and Game (CDFG). Large portions of this report are presented as comments 2-14 through 2-24, and are addressed individually below. It is appropriate at this point to note in response to this general indictment, however, that this report has been reviewed with great skepticism by informed members of the scientific and engineering community involved with Long Valley Caldera thermal resources for many years. Reviewers have no difficulty with the method of analysis employed, but the assumptions used cannot be related to actual data or substantiated. Most of the report's conclusions are, in fact, based on a preliminary analysis which the author has revised in the course of further work (see minutes of the LVHAC Meeting, 1/12/89, in Appendix H).

Comment: 2-5

Response: Pumping of geothermal water at MP I or at the proposed project could reduce flow at Casa Diablo Geyser, but flow could also be reduced or stopped by three other

mechanisms. They are (1) calcium carbonate precipitating in the fractures which carry the water, (2) caving or erosion of the fluid outlet, and (3) dissipation of the thermal water into the shallow freshwater aquifer during dry years. Any combination of these four mechanisms could contribute to decreasing flows at Casa Diablo. Flow paths characteristically are opened during earthquakes. It is possible that reducing production from wells in the Casa Diablo field would restore flows, but it is also possible that one or more of the other three mechanisms are responsible for diminished flow (as during the period 1972 to 1981).

Comments: 2-7, 2-89, 7-11, 7-16, 8-5, 8-7

Response: The accuracy of past temperature measurements is noted. As stated on pages 3-26 and 3-27, the H-2,3 spring varies in flowrate and temperature less than others in the hatchery spring group. The temperature fluctuation is believed to be due to its relatively low thermal component. It should be noted that if the H-2,3 spring's thermal component were completely cut off, the spring's temperature would be similar to that of Laurel Spring, a nearby spring with no thermal component. This temperature range is 52.7 to 54.1°F. Since the lower range temperatures of the broodstock springs are already equivalent to the non-thermal springs in the area, complete removal of the thermal component could not reduce the current lower range temperatures of these springs. The appropriate page has been revised accordingly.

Comment: 2-8

Response: Temperature data were reproduced in the Draft EIS/SEIR in units as originally reported. Degrees Farenheit have been added to the text for readers unfamiliar with S.I. units. For example, recent public documents and government agency reports use S.I. units in scientific papers. Degrees Centigrade were used for the heat-balance calculations for comparison with the Papadopulos report. Impacts were projected 40 years, even though the project life is stated to be 30 years. Temperatures would slowly rebound after 30 years as indicated by the calculated values at 40 years (10 years after shut-in). Because both temperature and pressure rebound are indicated after 40 years, calculation for periods 60, 80, and 100 years would only indicate continuing rebound. Figures 2-1 and 2-3 in Appendix C show project pressure and temperature effects for 40 years.

Comments: 2-14, 2-15, 2-16, 2-17, 2-18, 2-20, 2-24c, 2-52, 8-15a, 12-1 thru 12-5, 12-7, 12-8

Response: These comments are largely a description of the Papadopulos report's concept of how "thermal pits" are formed and "inevitably" migrate downstream to the hatchery springs area. They are not really comments on the Draft EIS/SEIR. We believe that the Papadopulos theory of uncontrolled hydrologic impacts migrating as "pits" is inaccurate. No example is known for a fractured geothermal (or any other) fluid reservoir behaving in such a fashion. What the commentor describes is a highly simplified view of chemical transport in an isothermal porous medium. Most significantly, the commentor's analogy does not account for dispersion of the fluid and reheating by contact with hot reservoir rock as it migrates.

The "crude models" used in the Draft EIS/SEIR referred to by the commentor include an updated and more detailed version of the heat-balance model used by the commentor in the initial Papadopulos report. The Draft EIS/SEIR heat-balance model is, in fact, an improvement on the commentor's version in that it uses input assumptions that conform to the known resource data. Furthermore, contrary to the commentor's assertion that the Draft EIS/SEIR "neither acknowledges this ultimate outcome (i.e., migration of heat deficit pits) nor attemps to analyze it in any meaningful manner," the bulk model analysis and accompanying migration calculation are specific attempts to quantify this impact. In contrast, the commentor makes no attempt to quantify this impact in his report, but rather simply asserts that it is significant and unmitigatable. The Draft EIS/SEIR models may be simplistic relative to the actual hydrothermal system, but they are far more sophisticated and realistic in input assumptions than the single, brief, preliminary analysis offered by the commentor.

This is not to say that the analyses presented in the Draft EIS/SEIR are perfect. The text several times cites the uncertainties involved with reservoir predictions, particularly for the Long Valley data base available at this time. Neither have the analyses been endorsed or embraced in entirety by qualified reviewers, such as those of the USGS. However, the authors believe that all the qualified experts agree that development is possible with a cautious approach involving an authoritative monitoring and management plan. See Appendix H.

Lastly, the commentor claims that his conclusions are valid regardless of the conceptual model that is applied to the geothermal system. This is clearly not the case for the fracture upwelling model since this model precludes impacts at the hatchery and gorge springs because they are then in separate thermal systems from the Casa Diablo system. Only by making the "worst case" assumption of lateral flow connectivity do any of the analyses presented apply.

The fact that impacts have not yet occured is important for input to the models. The models are constrained by the existing data. The results of the models have not been used as proof that impacts will not occur. Rather, they were used as a basis for the decision to implement a monitoring program.

Comments: 2-19, 12-6

Response: The fluid velocities calculated in the Draft EIS/SEIR are based on USGS data (Farrar et al. 1985; Sorey et al. 1978). The bulk permeabilities used for calculations in the Draft EIS/SEIR are averages based on data from Casa Diablo and Mammoth/Chance well tests. The values are not based on speculation. The values used can be considered higher than average, because those specific areas are within faults and accompanying fracture zones. The regions in between are probably less fractured and permeable, so the values used for calculating them represent worst-case values.

Comment: 2-21

Response: The commentor contradicts himself by stating that "the heat-balance model can only provide qualitative indications of the direction of long-term predictions of regional impacts, and it cannot produce quantitative predictions of the magnitude of impacts." Since the commentor's own conclusions are admittedly based on his own heat-balance modeling attempt, it is unclear as to how the commentor can conclude that the "PLES I project ... will have a significant adverse impact on the thermal component of spring discharges" unless he attempts to produce quantitative predictions in his own model if no quantitative prediction is possible from these models.

Comments: 2-22, 2-24a, 12-9, 12-11

Response: Block sizes should be chosen based on existing reservoir data. The block sizes and initial temperature assumed affect the calculated temperature changes. Expected (or pre-determined) results should not affect the size of the blocks chosen. It appears that the boundaries for the Papadopulos model were based on arbitrary assumptions, not on actual resource and well data. Though it is generally believed that his promised future modeling will be improved in this regard, this is not the proper approach to modeling. The results of models should indicate the extent of influence due to production at Casa Diablo, not the assumptions prior to running the calculations.

Comments: 2-23, 12-10

Response: This comment is another statement of the commentors opinion. No previous or continuing research considers the actual size of the resource in terms of areal extent or heat content to be as small as assumed in the Papadopulos report.

Comment: 2-37

Response: The Long Valley KGRA includes a much larger area than could be affected by this or any other project in the Mammoth/Hot Creek area. It would be both unnecessary and inappropriate to present data on thermal resources throughout the KGRA, and is not consistent with CEQ regulation 1501.15.

Comment: 2-46

Response: The text has been corrected on appropriate pages.

Comments: 2-51, 10-7, 13-9

Response: More accurate water use figures have been provided by Pacific Energy (see Table 10-2). These estimates are based on actual water use at MP I and estimated use at PLES I and MP II. Text on appropriate pages has been changed to reflect this recently acquired information.

TABLE 10-2: ESTIMATED AVERAGE GROUNDWATER USE IN GALLONS PER MONTH

	Year 1	Year 2	Year 5
Utilities:			
PLES I/MP II	6,000	6,000	6,000
MP I	3,000	3,000	3,000
Irrigation:			
PLES I	98,000	65,000	1,500
MP II	120,000	80,000	1,000
MP I	500	500	500
Total gallons per month	227,500	154,500	12,000
Average gallons per minute	5.27	3.58	0.28

SOURCE: Pacific Energy

Irrigation would require relatively large amounts of water during the first year. Water use for irrigation would decline as planting became established and is expected to stabilize at the level shown for Year 5.

It is remotely possible that the local shallow groundwater source currently used at Casa Diablo is in communication with the ponds in question. However, the ponds are more likely to be influenced by changes in annual precipitation and highway maintenance by CalTrans than by withdrawal for irrigation at Casa Diablo, especially in view of the limited water use at Casa Diablo. Should impacts to the perched water table be detected due to increased pumping of shallow cold groundwater at Casa Diablo, the most effective mitigation would be to reduce pumping. However, no impacts are expected.

Mammoth/Chance was not included because it is in a different shallow groundwater basin.

Comments: 2-42, 2-55, 8-16, 10-2

Response: Comments noted.

Comment: 2-48, 6-25a

Response: The reference on the appropriate page has been corrected.

Comments: 2-50, 3-33, 6-25b, 6-30

Response: Mitigation (7) has been changed.

Comment: 2-53

Response: The discussion in Section 4.1.4 has been expanded to give a more complete explanation of the purpose of monitoring and how monitoring will affect decisions implementing mitigation changes in reservoir production/injection operations at Casa Diablo. The authors agree that feasible and enforceable mitigation measures must be a condition of the project permit, and these are incorporated into mitigation measure (7). Detailed plans for implementation of these mitigation measures are required in mitigation (7), which must be completed prior to commencing commercial operations. The authorized officer of the BLM has full authority to approve or reject such plans. See mitigation (8) for protection of Hot Creek Gorge.

Comment: 2-54

Response: The use of cold water from wells was originally unacceptable for the Mammoth/Chance project because the proposed use was consumptive, i.e., evaporative cooling. The mitigation proposed in the Draft EIS/SEIR for cooling the hatchery springs with cold water from wells simply involves "rerouting" a small portion of the Mammoth/Hot Creek watershed groundwater or surface water flow through the hatchery springs. The end result of downstream flow into Hot Creek is the same and no cold water would be consumed.

Even if water treatment were required for recycled water , this would be purely an economic problem. There is no question of technical viability.

The discussion regarding the Effectiveness/Impact of mitigation measure (6) has been expanded to provide additional clarification.

Comment: 2-56

Response: The purpose of injecting geothermal fluid in the geothermal reservoir upgradient of Hot Creek Gorge is to maintain both the temperature and pressure of the gorge springs. Wording of the mitigation measure proposed for the Hot Creek Gorge springs has been revised to clarify the meaning. No replacement or repair of these features is considered possible or acceptable. Mitigation measure (8), injection of hot water up-gradient of these springs, is the only remedial measure being considered. The purpose of the monitoring program is to avoid impacts to these features by requiring changes in operations at Casa Diablo far in advance of changes in the reservoir near the hatchery or Hot Creek Gorge springs. The Forest Service considers Hot Creek Gorge a geologic interpretive site, and officially discourages public bathing.

Comment: 3-4, 7-2

Response: The initial Papadopulos report was reviewed and considered in the Draft EIS/SEIR. At the time of preparation, no indication of further analysis was given within the report of by the CDF&G. While an improved modeling effort was to be completed by mid-December 1988, no such follow-up report has been issued as of this writing in April 1989.

As stated above, (see response to comments 2-2, page 10-185, and response to comments 2-14, 2-15, etc., page 10-187), this report has been reviewed with great skepticism by knowledgeable reviewers.

Comment: 3-9

Response: The explanation preceding mitigation (6) explains the functioning of the mitigation/monitoring program. Specific mitigations to compensate for a decrease in thermal waters at the hatchery or gorge springs are described in Section 4.1.4.3 of the Draft EIS/SEIR. This explanation has been expanded in the Final EIS/SEIR to provide additional clarification. Approval of the details of how these mitigations are to be accomplished rests with the authorized officer. Replacing a geothermal spring component with similar geothermal water from elsewhere (the basis of all the proposed mitigations) involves a like-for-like exchange which should result in no significant difference in water chemistry or degradation of the aquatic ecosystem.

Comment: 3-10

Response: The EIS/SEIR for PLES I does not state that there is no risk from spills. There is a carefully designed spill containment plan to protect Mammoth Creek and Hot Creek from spills, which reduces the risk to insignificance.

Spills at Casa Diablo could occur from ruptured lines in the closed loop from production to power generation to injection. The geothermal fluid, however, is not used for other purposes, such as cooling, and is not treated to make it secondarily useful. Furthermore, there are no chemicals hauled to treatment plants in steep terrain over winding roads as in the Geysers. Because only about 15% of the Casa Diablo fluid flashes to steam, it does not concentrate chemical constituents markedly and the main danger would be from thermal effects. (These are described in Section 4.1.4.1) For these reasons we feel that comparison of the PLES I facilities to the Geysers facilities is still misleading even with the large volume of liquids being moved.

Comment: 3-11

Response: The mud pit would be lined in accordance with RWQCB specifications.

Comments: 3-25, 6-28

Response: The spill containment plan is included as Appendix A for those readers who want more information than is provided in the body of the text. The reliance on a manual closure system would occur only during project construction before the plant control room were operational, because there would be no means of activating automatic sluice gates. The construction period would last about nine months. Each well pad and the plant construction site would have spill containment facilities during all drilling and construction activities.

Automatically controlled valves and gates are commonly available and would be installed before operation began. The issue of spills and their potential effects were fully analyzed in Section 4.1.4.1.

Comment: 3-27

Response: The areas for the projects listed were taken from project maps and environmental documents. Snow Creek, Sherwin Bowl and Juniper Ridge all drain into Mammoth Creek, as does the part of Doe Ridge around the airport which is included in the cumulative analysis: The calculation is 13 / (13+ 60 + 400 + 200) = 0.0193. That is, 13 acres is less than two percent of the cumulative area.

Comment: 3-32

Response: The wording has been changed on the appropriate page to make the meaning clear.

Comment: 3-34, 8-18

Response: The hydrologic monitoring program required by the BLM includes all monitoring locations, methods and frequencies recommended for this project by the Long Valley Hydrological Advisory Committee (LVHAC) in their October 1987 monitoring plan. In addition to the LVHAC's 1987 recommendations, BLM is requiring monitoring of the Hatchery CD springs, monitoring the unnamed stream through the Casa Diablo area, monitoring the combined Casa Diablo Spring flow, and monitoring of the unnamed springs in Chance Meadow.

Table 2-4 describes BLM's Hydrologic monitoring requirements prior to the addition of the Chance Meadow Spring monitoring requirements.

The modifications made to the LVHAC hydrological monitoring plan in the May 1988 revision are found in Table 2-4. Under Sites, "New production and injection Wells..." is changed to "ALL production and injection wells...". Under Data Collection, last paragraph, last sentence," During development..." is changed to "During production...". CDG (Casa Diablo Geyser) monitoring is added. On observation well SF 65-32, the frequency of temperature, chemistry and isotopy monitoring is added (this was omitted in the Oct. 1987 version). None of these changes affects the BLM requirements as they are already required as part of the approved Plan of Baseline Data Collection.

All future changes in the LVHAC Hydrologic Monitoring Plan will be reviewed by the BLM. It is the BLM's intent to include all reasonable and pertinent monitoring recommended by LVHAC.

Comment: 3-40

Response: The Lahontan Regional Water Quality Control Board, as mentioned in Section 4.2.3.1, has storage requirements for hazardous materials.

Comment: 5-4

Response: The temperature range for the AB springs has been corrected to read 59.5°F to 64.5°F during the period 1976 to 1987.

Comment: 5-3

Response: The table is intended to indicate that water level/pressure data are to be measured continuously during the first year and on a monthly basis after the first year. Temperature profile, ionic and isotopic chemistry analyses are to be obtained semi-annually. Should monitoring done during the first year indicate a need for more frequent or different monitoring techniques the authorized officer may require it.

Comment: 6-9

Response: Monthly monitoring of spring temperatures was specified by the LVHAC and is considered adequate to detect any meaningful long term trends. If monitoring results indicate the need for more frequent observations, the authorized officer could require more frequent monitoring.

Comment: 6-10

Response: The pressure measurement device at SF 65-32 is a permanent and continuous installation. There is no plan to change this after the first year. However,the authors concur with recommendations from the LVHAC that monthly data, after one year, are sufficient to establish long term trends in observation wells. As with all monitoring requirements, the authorized officer can change the PBDC.

Comments: 6-24, 13-10, 13-11c

Response: The EIS/SEIR now includes an estimate of Mammoth Creek temperature impacts in the event of simultaneous failure of pipelines at all the plants at Casa Diablo. See pages 4-32 to 4-33.

Comments: 6-31, 6-32, 6-33, 6-36, 6-63, 8-20

Response: The BLM has full legal authority to enforce stipulations placed on the project. The authorized officer would base decisions on all available data, not just specific information from a few wells or springs. Specifying trigger points would require development of a multitude of scenarios with the likelihood that none would describe the actual situation. Mitigation measure (6) has been revised to indicate that the entire body of data produced by the monitoring program will be evaluated at least annually to determine implementation, as necessary, of addition monitoring and mitigation measures. Other revisions to clarify the monitoring and mitigation program have also been included.

It is feasible to carry out the entire monitoring/mitigation plan as it is appears in the Final EIS/SEIR. The plan includes provisions for substantial mitigation which would be based on data supplied by the monitoring program. It is an integrated approach to effective mitigation.

Comment: 6-34a

Response: While the monitoring of a great number of natural features are included in the monitoring program, the features of greatest importance for detecting early changes in the geothermal reservoir, prior to any impacts to natural hydrothermal features, are man made features (production, injection and monitoring wells). Detection of significant changes in the developed geothermal reservoir will allow imposition of mitigation measures, which will prevent these reservoir changes from migrating to significant natural features. In this way impacts to significant natural features as defined by NEPA, will be avoided.

Comment: 6-35

Response: See mitigations (7) and (8), pages 4-60 and 4-61.

Comment: 6-46

Response: The BLM does not have jurisdiction over MP I, which is located on private property, and cannot require implementation of mitigation measures at MPI.

Comment: 6-62

Response: With the implementation of the monitoring/mitigation plan, it is unlikely that it would ever be necessary to provide thermal water to the hatchery. Since the feasibility of providing water has been demonstrated in Section 4.1.4, it is not necessary to construct the water supply system without any reasonable expectation that it would be needed. The text has been expanded to clarify the Effectiveness/Impact of this mitigation measure. See also mitigation (7) which requires the development of an implementation plan to ensure that any necessary additional monitoring or mitigation can be implemented in a timely manner.

Comments: 8-4, 8-13, 8-15b

Response: The text has been edited.

Comment: 8-17

Response: The explanation on the appropriate page has been expanded.

Comment: 8-19, 8-21, 8-22, 8-23, 14-1

Response: Based on internal BLM review and the expert advice of the LVHAC Hydrologic Subcommittee and consultation with Forest Service, BGI, Mesquite Group, and BLM experts, mitigation measure (6) has been revised to delete the drilling of a monitoring well into the injection zone near well 65-32 (mitigation (9) of the draft and not to require the drilling of the second monitoring well at this time. Appropriate changes have been made in the text. Pressure changes in the injection zone can and will be effectively monitored through wellhead pressure meters and annual pressure fall-off surveys conducted on the injection wells. No data yet produced indicate a technical need for drilling a second monitoring well at this time. As specified in mitigation measure (6), the BLM will continue to review and analyze the available data and will require implementation of these mitigation measures should changes in the reservoir, beyond normal variations, be observed.

Comment: 10-4

Response: LVHAC has wide membership which reviews all the data on behalf of Mono County. Although the operator is responsible for monitoring, there is enough redundancy in measurement taking that falsification of data or improper monitoring is not in the operator's interest. The authorized officer may require independent checks of equipment and techniques at any time.

Comment: 13-2

Response: The text has been corrected.

Comment: 13-4

Response: The zone referred to is that defined by repeated surveys in MBP-2 and UM-1 as shown on Figure 17 in Appendix C. Because IW-1 is across a major fault (Taylor/Bryant) and is an area outside that proposed or actually used for production or injection its profile was not included. Hence, the zones referred to were at elevation 6600 to 5400 ft at Shady Rest and 7100 to 6600 ft at Casa Diablo. The zones boundaries are not definitive but do intersect the same elevation. However, the statement in the EIS refers to the offset between the top of the zones at each area.

Comment: 13-5, 13-11b

Response: The three reports cited (including Setmire, 1984) were reviewed for indications of any degradation of surface water quality in the region since the 1960's. The only water quality problem noted was fecal coliform due to cattle grazing. The authors believe that the context of the discussion, the remoteness in the time frame of the geothermal discharge (1962) versus the reference (1984), and the title of the reference ("Water-Quality Appraisal of Mammoth Creek and Hot Creek, Mono County, California") make it clear that the Setmire report was not a specific investigation of the 1962 geothermal discharge. The Department of Water Resources report in 1967 acknowledged the 1962 geothermal discharge, but made no note of any lasting effects. The point of the discussion in the Draft EIS/SEIR is that if serious consequences had occurred as a result of the spill, it is likely that they would have been noted.

Comment: 13-6

Response: The text has been revised.

Comment: 13-8

Response: Both the alluvium and basalts overlying the Early Rhyolite thin from north to south in the Casa Diablo area. The fresh ground water from these overlying rocks is tapped by the existing water well about 200 yards northwest of the MP I power plant. At the location of SF 35-32 south of the plant, there is no groundwater because there is virtually no alluvium. Furthermore, the size of the watershed and basin contributing to surface and ground water flow in the Casa Diablo area is insignificant compared to that of the main Mammoth/Hot Creek drainage. The text in Section 4.1.4.2.1 has been revised.

Comment: 13-11a

Response: As mentioned in the Draft EIS/SEIR, the most significant potential impact to Mammoth/Hot Creek water quality would be due to an uncontained spills of large quantities of geothermal fluid. Because this would be a short duration event, the greatest impact is considered to be due to the temperature effects (see analysis, Section 4.1.4.1). Based on the same scenarios used to calculate the mixed fluid temperatures (geothermal plus creek water), a table could be constructed to show the mixed fluid chemistry. However, this cannot be done as easily by simple mathematics due to potential changes in chemistry as a result of the mixing. Furthermore, no chemical constituent found in the geothermal fluid, would, after mixing, result in a concentration likely to have an impact on the aquatic environment given the short term nature of the event.

Comment: 13-12

Response: The commentor is correct to be skeptical of detailed results of the numerical modeling performed thus far because of an insufficient data base. However, the authors believe that the commentor overstates the "unreliability" of results as indicators of the general magnitude and direction of impacts. In the Draft EIS/SEIR three independent, commonly used reservoir modeling techniques have been employed to predict worst-case reservoir temperature and pressure changes which could occur as a result of the PLES I Project in different areas assuming the Lateral Flow model is correct. As described, the use of conservative reservoir values in the modeling means that the actual changes will

be substantially less than those predicted. Maximum temperature and pressure changes of 15.4°C (27.7°F) and +2.2 psi were predicted in the Casa Diablo reservoir and -2.6°C (-4.7°F) and +0.55 psi in the Hot Creek reservoir after 30 years of PLES I operation. As noted, a pressure change of +2.2 psi in the Casa Diablo reservoir is insignificant, although the worst-case prediction of a 15.4°C (27.7°F) temperature decline in the Casa Diablo production reservoir would decrease the ability of the power plant to operate efficiently.

These model calculation indicate that, assuming hydraulic communication exists, the potential for significant subsurface changes to extend the three to five miles to Hot Creek Hatchery and Hot Creek Gorge is very low. What is more difficult to precisely predict is the effect that these small predicted temperature and pressure changes in the geothermal reservoir will have on the hatchery and gorge springs. At the hatchery springs, it is estimated that approximately 3 percent of the flow is thermal water. The temperature of the thermal fluid component of these springs is unknown; but it is estimated that a loss of the entire thermal component could result in a lowering of the average spring temperature of 2° to 3°C (3.6°F to 5.4°F) (Sorey, M.L., 1976).

No effects have been measured at the hatchery or gorge springs to date, and none would be anticipated on the basis of the reservoir measurements made to date at Casa Diablo. Based upon the minor changes in reservoir temperature and pressure predicted to occur under these worst-case examples, and considering the complex nature of the hydrothermal connection to the surface, it is extremely unlikely that any significant impacts would occur to the distant thermal features of concern.

The authors certainly agree with the commentor's concluding remarks.

Comment: 13-3

Response: Thank you for indicating this error. The 73°C reading is anomalous and should not have been included in the summary description. The sentence on p. 3-26 now reads, "seasonal spring temperatures have varied from 90° to 94°C (194 to 201°F) at HC-1, 76.2° to 92°C (169° to 198°F)at HC-2 and 88.3° to 92.8°C (191° to 199°F)at HC-3 during the 1983 to 1985 monitoring period." Further the sentence has been qualified with the statement: "Measured temperature fluctuations may result from spring conduit clogging and resulting flow losses."

10.3.4 BIOLOGICAL RESOURCES

Vegetation

Comment: 3-26, 6-15, 10-6

Response: Figure 3-5 includes the alternative power plant site and pipeline routes. It does not show the ephemeral ponds to the west for which detailed surveys have not been conducted. However, as the EIS/SEIR states, the ponds would be protected and their biological resources not impacted by the power plant at the alternative location through the mitigation measures.

In accordance with NEPA (1502.14(b)), the EIS presents sufficient information to evaluate the relative levels of environmental impacts created by each of the alternatives. Knowing more about the resources of the ponds is not required to understand that the environmental effects of the alternative location are greater.

Comment: 2-49

Response: All habitat types in the immediate area could be affected, although the text has been revised to clarify the point. See Figure 3-5.

Comments: 3-12, 3-14, 3-37

Response: Areas where seedlings and larger plants would be planted are shown on maps submitted to the BLM Bishop Resource Area. In general, they are the graded areas between project facilities (well heads, power plants, and appurtenant structures) and public roads. The larger plants would screen the facility from view. The landscape contractor is required to guarantee a success rate of 70% for a five year period (Appendix B, page 4). The authorized officer is responsible for monitoring to ensure that the project is carried out as described.

Comment: 2-68

Response: A mitigation measure has been added to section 4.2.2.5.

Comment: 2-78

Response: A description of the earth ramps has been added to Section 2.1.6.9.

Comments: 2-6, 2-25, 2-36a, 2-57, 2-59, 2-60, 2-79, 2-80, 3-35b, 3-36, 4-1

Response: Neither of the two identified biologically sensitive habitats, namely rhyolite buckwheat or thermal marsh, would be directly impacted by the proposed project (Figure 10-1). It is possible that botanically sensitive rhyolite buckwheat areas could be damaged during construction activities near injection wells, but only if equipment is driven outside designated areas. The wording has been changed to clarify how damage might occur to rhyolite buckwheat and to add a mitigation requiring clearly marking rhyolite buckwheat areas, which would minimize the potential impacts of accidental contact during construction activities.

Casa Diablo geyser could be impacted by the project, but historically it has had highly variable flow. From 1972 to 1981 it did not flow, then it began to flow in 1982 and the flow increased after the 1984 earthquakes. The geyser has been inactive since April 1987 which may be related to the current drought conditions in the area.

Revegetation of a thermal marsh would be ineffective if thermal water were no longer being supplied to the marsh. That action is not suggested as a mitigation in this document since no marshes would be affected by PLES I except, conceivably, the one at Casa Diablo and it has not had thermal water since 1987 and did not have it for the period 1972 to 1981.

The impacts to the thermal marsh at Casa Diablo and the rhyolite buckwheat scrub mentioned by Taylor and Buckberg (1987) in Appendix D occurred during the long history of this area and are not related to this project. Their survey was used in siting the facilities so that the proposed project has implemented all the mitigations recommended in the study for rhyolite buckwheat habitat. As stated in Section 4.2.1.1, no rhyolite buckwheat would be directly impacted by PLES I. Their recommendations with respect to Casa Diablo geyser are not appropriate because that area is not part of the PLES I project site.

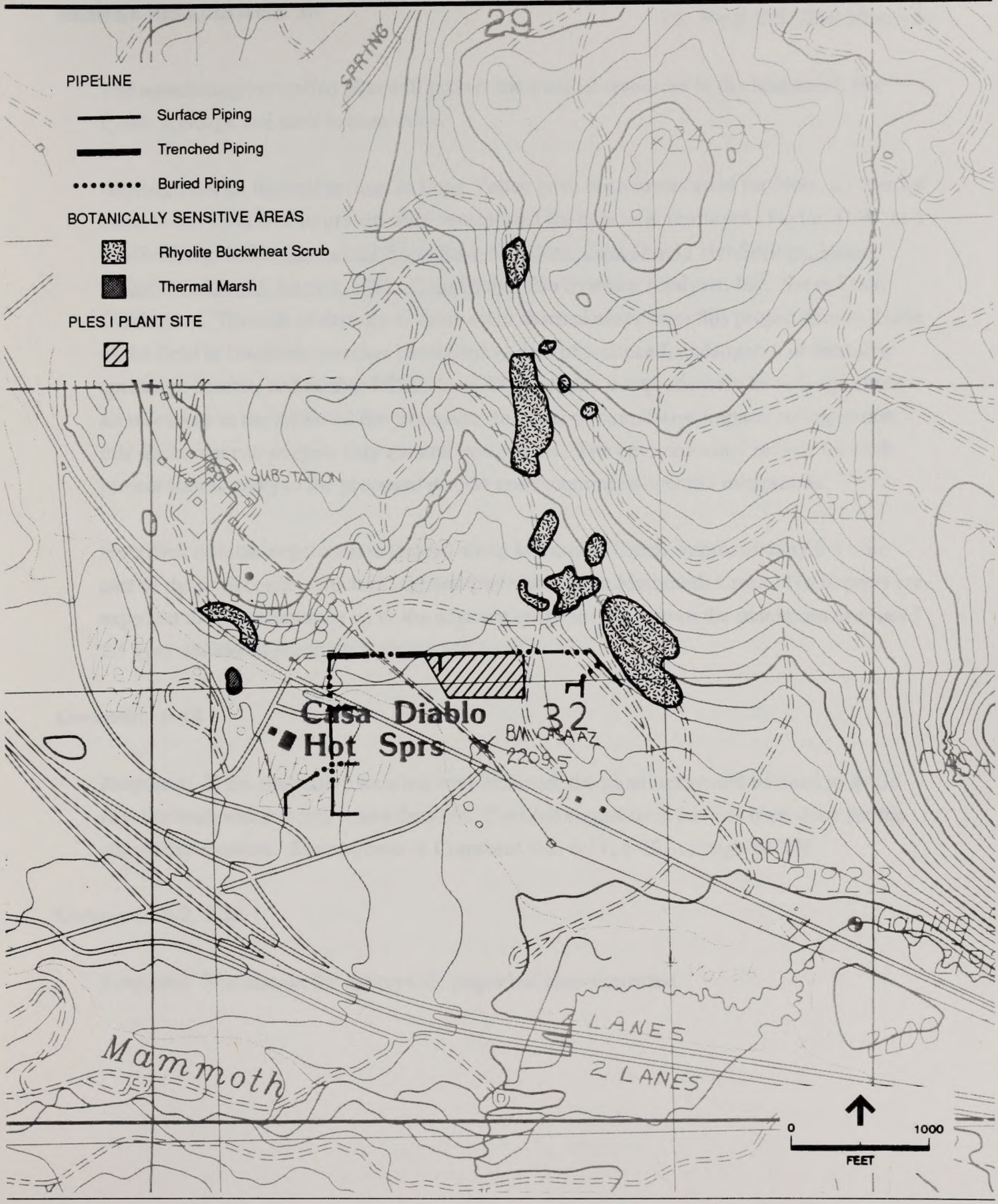


FIGURE 10-1
Locations of Botanically Sensitive Areas
in Relation to Proposed Project Facilities

SOURCE: Biosystems Analysis Inc., Jan 1987;
Pacific Energy

The monitoring/mitigation plan will protect the thermal resources in the Mammoth Hot Creek drainage and their habitat value.

Although not all thermal springs in Long Valley have been inventoried for biota, all thermal areas in the Casa Diablo graben were inventoried for botanical resources (Taylor, D.W. and R. Buckberg, 1988. Terrestrial Biota Base-line Data, Casa Diablo Hot Springs, Mono County, California August, 1988. Casa Diablo Bio Systems Analysis, Inc., Santa Cruz, California). The risk of damage to these other thermal areas from this project is low. None of the field or literature searches conducted to date of treatened, endangered or sensitive species or habitat, and neither NEPA nor CEQA require comprehensive knowledge about all resources in the Affected Environment. In terms of cumulative impacts to vegetation, this document can suggest only general mitigations. The environmental review for each project should analyze the proposed project and recommend specific mitigations.

Identified riparian vegetation is located along Mammoth Creek, approximately 0.6 mile east of the project site, which is supported by water from Mammoth Creek. No impacts are expected to this community or to the adjacent sedge meadow from the maximum estimated 2.5 gpm additional pumping from the MP I well.

Comment: 6-14

Response: If the alternative location were selected, the pipelines would be sited to avoid rhyolite buckwheat scrub, where feasible. Detailed engineering has not been done for the alternative location. See response to Comment 6-2, 6-11, 6-12, ..., page 10-176.

Comment: 8-2, 8-26

Response: The text on the appropriate pages has been corrected.

Terrestrial Wildlife

Comments: 2-9, 2-11, 2-61, 2-62, 2-66, 2-69, 2-70, 2-71, 2-83, 2-84a, 2-85, 2-86a, 3-38, 6-38, 6-40

Response: Although the project vicinity supports a diversity of resident and migratory wildlife, the removal of 13 acres of sagebrush scrub and Jeffrey pine wildlife habitat by siting the proposed power plant is not expected to significantly impact any of these species given the abundance of these habitats in the project area. Furthermore, as part of the project design, disturbed areas would be revegetated as outlined in item 24 of Section 2.1.1.

In terms of potential project impacts on wildlife species of special concern, the project area appears to offer minimal to moderate value to each of the eight migrant or resident species discussed in Section 3.2.2. Each species, while potentially using a portion of the area at a given time, generally uses a much larger area or an area outside the project area for the majority of its foraging, resting, and mating activities.

For example, the sage grouse is dependent on sagebrush stands for nesting, thermal cover, and feeding during the fall and winter. Large open areas in the sagebrush are used for strutting grounds (leks) during the breeding season. While the southern portion of the survey area (see Figure 3-5) provides limited amounts of moderately suitable sage grouse habitat, the vital lek habitat does not occur in the immediate vicinity of the survey area. Thus, the site provides for moderate rather than essential sage grouse use.

The wildlife cumulative impact discussion estimates the total number of acres of habitat that would be altered resulting in the potential loss of foraging and nesting areas for the goshawk, pygmy nuthatch, and hairy woodpecker. Removal of this quantity of habitat is not expected to be a significant loss for any of these species and mitigation is unnecessary.

The Draft EIR/EIS suggests that cumulative impacts to deer herds are potentially significant. This tentative assessment is based on the inclusion in the cumulative analysis of Sherwin Bowl and Snow Creek, both of which are in a major migration corridor, constricted by topography and/or existing development, leading across the Sierra Nevada to summer range. With respect to the geothermal plants located at Casa Diablo, Kucera (1987) states:

> "Assuming a 'worst case' scenario, one in which deer completely avoid proposed facilities and associated human disturbance, it is difficult to see how making several dozen deer move several hundred yards around the facilities would constitute a great hardship. Given the existing terrain, such an avoidance would have a trivial impact on migrating deer. Of course, certain facilities, e.g., fences, pipelines, etc., could be designed to minimize any impacts to deer and to facilitate their passage... There will be loss of summer habitat causing some reduction local carrying capacity and fawn production. Regarding migration, in the worst and unlikely case that deer avoid the project entirely, there are at present alternate routes available to allow migrating deer to reach their summer ranges. Thus, the Casa Diablo Geothermal Project (both the Mammoth Pacific Geothermal Project and the PLES I Geothermal Project) by itself will likely have minimal negative impact."

Taylor (1988) (Appendix D) discusses summer habitat utilization and clearly identifies quaking aspen riparian habitat as the major type utilized by the radio-collared deer from the Casa Diablo herd. Deer summering in areas consisting primarily of Jeffrey pine and Great Basin sagebrush habitat, typical of the Casa Diablo project area had home ranges more than twice as large (averaging 384 hectares or about 950 acres) as those deer ranging in riparian habitat (34 to 167 hectares or 84 to 413 acres) (Taylor, 1988). From these observations, the carrying capacity of the Casa Diablo project areas as potential deer summer range can be estimated as follows:

> Construction of the PLES I project would disturb about 13 acres. Since it requires about 950 acres of Jeffrey pine or sagebrush scrub to support one deer, the loss of 13 acres represents the loss in carrying capacity of 13/950 = .014. If one conservatively assumes that noise and human activity at the plant cause deer to completely avoid an area within 0.25 mile of the plant, than an area of 126 acres would be impacted. The carrying capacity loss would be 126/950 = 0.13. Therefore, in the worst case, the land required to support 0.13 deer would not be available as habitat. This does not result in an annual loss of 10 does and 15 fawns.

The project area has not been designated critical deer habitat and in fact receives rather light use by deer. None of the radio-collared deer followed in Taylor's study crossed the site and Kucera's tracking study provides the most accurate information available on use of the site. We believe that the proposed action is in conformance with the deer herd management plans, and the comment does not indicate why conformance is not achieved. See also response to comments 2-12b, 2-36c, ... page 10-173 and page 2-1.

We can find no basis in the California Department of Fish and Game's statement that implementation "of the project as proposed would result in non-compliance" with the

referenced Buttermilk, Sherwin Grade, and Casa Diablo Deer Herd Management Plans. Each plan provides numerous general management unit goals, programs, objectives and prescriptions regarding the respective deer heard and its habitat which the signatory agencies are to consider as each carries out its own directives. As the Department did not identify which plan elements it believes would be compromised by the implementation of the proposed project, each plan has been reviewed. Because the proposed project area is not critical or key winter or summer deer habitat or a critical deer migration corridor, and because it is not anticipated that there will be any significant impact to any of the deer herds, few of these plan elements are directly, or even indirectly, applicable to the proposed project or any of the alternatives. Upon review of the plans, we disagree with the Department's statement and believe that implementation of the proposed project would not be in conflict with the various elements of each of these plans.

Comments: 2-38, 2-39, 2-82, 2-86b, 3-16, 8-6

Response: Part g) of Section 3.2.2 states "...deer from the Casa Diablo herd are thought to cross the survey area as they migrate.. to summer range."

Appendices D and E both substantiate that the Casa Diablo project site lies within the migratory corridor of the Buttermilk, Sherwin Grade and Casa Diablo herds, but neither of these reports defines the site as an irreplaceable portion of the migratory route given the "generally somewhat dispersed pattern of deer activity in and movement through the Study Area" (Kucera, 1987). Taylor and Buckberg's biotic survey in Appendix D identifies specific trails and "yarding" areas concentrated in the eastern and northern portions of the study area based on sign observed November 25 and 26, 1986. By contrast, Kucera's track studies (1987) were carried out on 37 days in the period April 22 to November 14, 1986. Conclusions reached on the basis of Kucera's work indicating dispersed use of the site cannot be invalidated by Taylor and Buckberg's observations.

The authors of the Biotic Assessment note the limitations of this survey both on page 11 where it was noted that "no quantitative assessments of habitat parameters were measured on the study area. The field visits provided only qualitative assessments of habitat suitability" and on page 26 where they noted that the Deer Observation Map, Figure 4, was

"based only on observations conducted during November, 1986." Kucera's report on the other hand include actual deer track counts and over a period which include the periods on spring migration, summer, and fall migration 1987. Where there are conflicts between the two reports especially regarding use of habitat by deer, we consider Kucera's report more authoritative.

Results from on going tracking studies would be included in the information used by the authorized officer to determine fencing and deer crossing ramp locations and to limit noise intensive activities.

Comments: 2-35, 2-64, 2-65, 2-72, 2-84b, 3-39, 6-8, 6-41, 8-24, 8-25

Response: Pipeline configurations for the proposed project are shown on Figure 2-1. Not only does this figure show pipeline routing, it shows areas where pipelines would be trenched or buried. Appropriate text has been edited to make entirely clear that Figure 2-1 is accurate.

Only single pipelines (i.e., lines from one well) outside fenced areas are neither buried nor trenched; multiple lines have buried sections or trenched sections. They can, at the direction of the authorized officer in consultation with CDFG and other agency wildlife biologists, be crossed by deer crossing ramps.

It is unlikely that deer could be fatally trapped by a single pipeline less than three feet above the ground and no more than 24 inches across. Although the information from Sunset Western Garden Book is not a scientific journal article, it relates commonly observed behaviour when deer encounter barriers.

The distances deer can jump are mainly related in anecdotal accounts. However, studies summarized by Taylor (1975), done on white-tailed deer indicate that deer routinely jump distances of 12 to 20 feet when running and have jumped as much as 30 feet. They have also been observed to jump 8-foot high fences without a running jump.

The description of measures included in the project description in Section 4.2.2.1 has been expanded to remove ambiguity about precisely what is included to reduce impacts to deer to levels of insignificance.

See response to comments 2-3, 2-63b, etc., page 10-170, and 2-9, 2-11, etc. p. 10-207

Comment: 2-77

Response: Comment noted.

Comment: 2-67

Response: The argument used by Kucera is that less habitat is affected if impacts are aggregated. That argument can be used just as effectively when comparing the presently proposed project to the alternative location north of the hill as it can when comparing the original site adjacent to MP I with its alternative (the presently proposed project). In fact, the argument applies more strongly in the current situation, because the well fields remain in the same locations for both alternatives, but longer pipelines would be required for the more distant power plant and human activity and noise would affect a larger area.

Comments: 6-44, 10-1, 10-8, 10-11

Response: In general, the same kinds of techniques would be used in construction at the alternative site as for the proposed project. This would include burying some segments of the pipelines, trenching other segments, and constructing ramps for deer to use in crossing trenches. No additional mitigations would be feasible and there would still be more pipeline and a larger area impacted by the plant at the alternative location. The text has been edited in Sections 4.2.2.2 and 4.3.6.2 to list mitigations for the alternative location.

Comment: 2-36b

Response: Noise impacts to deer are described in Section 4.2.2.1. Noise-intensive activities are specifically restricted during deer migration periods as stated in item 12, Section 2.1.1. The dispersed nature of deer use in the area makes it possible for deer to avoid activities at the project site. Section 4.2.2.1 has been edited for clarity.

Comment: 6-42

Response: The appropriate text has been edited.

Comments: 6-43, 10-3

Response: Sufficient mitigation has been applied to reduce impacts to deer habitat to an insignificant level, so no compensation appears appropriate. If a mechanism could be

developed whereby contributions were made on the basis of the project's relative contribution to impact, it could provide protection for those deer using the Casa Diablo area. A cooperative agreement between the Town of Mammoth Lakes, Mono County, BLM, and the Forest Service would be desirable, but no such agreement exists at this time. See also response to comments 2-9, 2-11, ... and 2-12, 2-36c, page 10-207.

Biological Environment - Aquatic Resources

Comment: 2-4, 2-26

Response: As noted in the comments, limited information is available on the aquatic invertebrates in the project vicinity. However, the proposed project has been designed such that disturbance to the aquatic resources, either of Hot Creek and Mammoth Creek from the potential accidental release of geothermal fluid or to thermal springs from geothermal fluid production or injection has been decreased to insignificant levels. Accordingly, although a survey and inventory of invertebrate resources in the project vicinity maybe of interest to the CDFG, neither NEPA nor CEQA require comprehensive knowledge of resources which will not be significantly impacted by the project. See also response to comments 2-6, 2-25, page 10-204.

The monitoring/mitigation program included as part of the proposed project is a phased series of mitigations which would be implemented in response to results of the monitoring program. It would prevent damage to geothermal features from migrating away from the Casa Diablo field. See Section 4.1.4 for a full discussion of both surface and subsurface water quality and resources.

Comments: 4-2, 7-6

Response: As the EIS/SEIR makes clear, is unlikely that the thermal component of springs supplying the spawning facilities would be lost, but the potential worst case is considered. It is true that of all California hatcheries, Hot Creek is the only one to operate year round. Hot Creek Hatchery could function without a thermal component, but it would not be as productive as it is now. Without the thermal water contribution, it could not have fall-spawning trout.

For a full discussion of the geothermal resource, see Section 4.1.4.3 (as revised).

Comments: 2-40, 2-47, 3-42

Response: The appropriate pages have been corrected.

Comments: 3-41, 3-43, 3-45, 6-27, 6-45, 7-18, 8-14

Response: As stated in Section 4.2.3.1, a bioassay of the geothermal fluid would be required under the revised Plan for Baseline Date Collection prior to project approval. The bioassay should not be considered a mitigation, and Sections 4.2.3.1 and 4.3.3.1 have been edited to include an appropriate mitigation.

Comments: 2-73, 3-8, 3-46, 6-26, 6-29, 6-49

Response: There are no data to support the theory that a geothermal spill would have the catastrophic effects which the commentors portray. Mammoth Creek has a small, variable, natural component of geothermal input, but in the 1960s, a geothermal well was intentionally flowed into the creek for 60 days. There is no evidence that this flow produced the impacts assumed by the commentors, and it certainly has not affected the streams' classification as a blue ribbon trout stream today. The entire spill containment plan is mitigation for geothermal spills. See Section 4.1.4.1 for the discussion of spills. Pacific Energy has committed to restock the stream to speed reestablishment of natural populations. (No additional bond would be required because Pacific Energy has both bonds and other financial obligations sufficient to restrock the stream. Trout from above and below the reach of stream potentially affected could recolonize the stream after normal temperatures were restored, as could organisms lower on the food chain. The authorized officer has the authority to require clearing streambed if sediment is delivered to Mammoth and Hot Creeks.

Comments: 2-1

Response: Comments noted.

10.3.5 SOCIAL ENVIRONMENT

Cultural Resources

Comments: 6-47, 8-8

Response: Comments noted.

Recreational Resources

Comments: 6-51, 7-4

Response: Sight-seeing has been added on the appropriate pages.

Comments: 6-48, 6-50

Response: Recreational resources of the area are described in Section 3.3.3. The discussion of impacts on in Section 4.1.4.2.6 includes those recreational impacts which could reasonably be expected by the project. Those impacts are limited as is the discussion.

Comments: 2-74, 2-75

Response: The recreational value of the thermal features is described in Section 3.3.3.0. Thermal water is hot water; it is mentioned in Section 4.3.3.1. The mitigation measures are described in full in Section 4.1.4.3.

Comments: 7-5, 7-7, 7-8

Response: The Forest Service considers Hot Creek Gorge a geologic interpretive site, and officially discourages public bathing. See the discussion of the monitoring/mitigation program in Section 4.1.4.3. The monitoring/mitigation plan is designed to identify and eliminate negative impacts long before they could reach Hot Creek Gorge. A mitigation for the worst-case situation suggests injecting make-up water into the reservoir, not into the creek.

Comment: 7-12

Response: Comment noted.

Timber Resources

Comment: 8-9

Response: Comment noted.

Transportation

Comment: 11-1

Response: Comment noted.

Visual Resources

Comment: 3-6

Response: Upon reconsideration of the effectiveness of the landscape plan, trenching and burying pipelines, in conjunction with similar plans for PLES I, and reconsidering the evidence presented regarding the lack of project impacts to mule deer, the Mono County Board of Supervisors unanimously approved the MP II project on December 6, 1988.

Comment: 3-47, 3-51

Response: The discussion in Section 3.3.6.1 explains the Visual Management System (VMS) used by the Forest Service. The visual environment can be made worse by additional development and simply because there are unsightly facilities (such as those listed in Section 3.3.6.4), they should not be used as justification for locating the project at the proposed site. However, the extensive measures included in this project would screen the new facilities and improve the appearance of the existing geothermal development. Section 3.3.6.2 has been corrected to read Section 3.3.7.2.

Comments: 6-52, 10-9

Response: The viewpoint used for the analysis was selected by the Forest Service. As stated in Section 3.3.6.4, this point is the viewpoint from which most viewers would see the project. The thousands of acres from which the project area is visible include land many miles away. The project, when viewed from several miles away, would be almost imperceptible to the naked eye. Landscaping and neutral earth tone colors used for painting would make it inconspicuous, even from a mile away. Terrain also screens it from view from many nearby areas.

Comment: 3-7

Response: There is no evidence provided in the comment that landforms could not be restored. The terrain is gently sloping or level and could be easily recontoured after wells were plugged and surface facilities removed.

Comment: 3-50, 6-53, 7-9

Response: Appendix B describes the revegetation plan in considerable detail, including species to be seeded, transplanted as seedlings, grown in container, or tree spade transplanted. The landscape treatment at well sites, pipeline segments, and the plant site is also described in Appendix B. Irrigation, planting, trenching, and retaining walls are also mentioned.

Since the Draft EIS/SEIR was circulated, 30-foot tall pines have been transplanted on the site. This would reduce the time to meet the VQO to no more than five years - the time to establish vegetation. The text has been edited. The VQO is a guideline, not a regulation. Compliance is not an issue.

The general nature of the lighting is described in Section 4.3.6.1. As with all these features, the authorized officer is responsible for compliance with stipulations (see response to Comments 2-30, 2-31, p. 10-172 ...).

Comments: 5-1, 5-2

Response: The grading plans for the power plant balance cut and fill so that no spoils are produced. Since the landscape plan effectively screens the power plant, in this case it is not necessary to change the grading plans.

Some of the pipelines would be buried and some trenched, although the trenches would not be lined. The spill containment basins would collect any liquid which escaped from bermed areas.

Comment: 7-13b

Response: The alternative location does provide better visual screening of the power plant. However, piping water to the power plant would require pumping more water to the power plant, partially because heat would be lost due to the longer pipeline, but also because the alternative site is at a higher elevation and pumping requires energy. There is no way to transport the geothermal fluid without using part of the power which is generated at the plant to do the work, and since the alternative site is both higher and further away from the producing wells than the proposed site, more geothermal fluid must be pumped to supply the necessary energy. Heat loss from the line is a less important factor since the lines already are heavily insulated - with relatively low temperature resource such as the one found at Casa Diablo, it is important to preserve as much heat as possible. Improving the insulation, which already increases the overall pipe diameter by as much as ten inches, would increase the height of the pipelines, making them more visible and more difficult for deer to jump.

Locating the power plant at the alternative site to totally mitigate visual impacts of the power plant, which with the landscape plan and other measures are minor, would be accomplished at greater impact to wildlife and increased risk of spill. However, the alternative location is viable and the decision makers could select it.

Comments: 3-48, 3-49

Response: Screening all lighting is part of the proposed project. See item 18 in Section 2.1.1.

Comment: 10-5

Response: The appropriate page has been edited as requested.

Land Use and Planning

Comment: 3-52

Response: Comment noted.

Comment: 6-60, 6-61

Response: The proposed project is not inconsistent with the concept of Mammoth Trout Park. The potential risk to the riparian habitat of Mammoth and Hot Creek is very low. If a spill were to occur, it would be containable, short-term, and mitigable. Flow would stay in the existing streambed and flooding would not result. Riparian habitat along Mammoth and Hot Creeks are at far greater risk from natural flooding and grazing impacts (see Taylor and Buckberg, page 16) than from the geothermal facilities.

The concept of a National Recreation Area in and of itself does not preclude commercial or light industrial development. Natural Recreation Areas encompass many combinations of environments, from those which are nearly wilderness to those in urban settings.

The National Recreation Area Concept is in its infancy, with no maps yet published to show the area which could be included. Some areas would be required for commercial and industrial use - the immediate Casa Diablo area which already has one power plant, an electrical substation, and transmission lines, would be logically designated as suitable for light industrial use.

Comment: 3-3

Response: When the geothermal lease was granted, pursuant to the programmatic EIS and Lease Block I EA, it granted the rights to develop the resource, if it were properly mitigated to protect the environment.

We do not agree that the construction and operation of the PLES I project would have a significant impact on tourism or the recreation values of the Long Valley Area. We support the designation of the Long Valley area as an outstanding recreation area, and we have carefully planned this project so the landscaping and operation of the power plant would not interfere with the recreational values of the Long Valley area. Migitation measures have been developed through the environmental review process to prevent interference with the tourism and recreation values of the area. Water consumption would be controlled at all times and would be limited. As discussed above, the specific location of the power plant was selected so as to prevent impacts to recreation and to maintain the open-space environment of the Long Valley area.

Economics

Comment: 6-64

Response: We disagree. Agencies must be prepared to carry out their normal business, including appeals to decision. This cost is not part of the economics of the project.

Comment: 2-27

Response: As stated in Sections 3.3.7.3 and 4.3.9.1, it is possible to obtain trout eggs on a year-round basis for $10 to $20 per 1,000 eggs, depending on the number purchased. The 800,000 Coleman strain eggs which could not be produced without the thermal water component at Hot Creek Hatchery would be worth almost $16,000 at prices prevailing in mid-1988.

The California Department of Fish and Game has produced no evidence to support the contention that these eggs would be worth $250,000 if they were available.

Comment: 3-53

Response: The dollar values are shown in Section 4.3.9.1.

Comment: 8-27

Response: Section 4.3.9.1 has been edited to include the suggested wording.

Community Services

Comment: 6-65

Response: On-site fire-fighting equipment is described in Section 2.1.5.3.

Comment: 10-10

Response: Section 4.3.10.1 has been edited to correct the inaccuracy.

Geothermal Resource Lease

Comment: 6-66

Response: This document identifies no significant, unmitigable impacts which would preclude approval of the project.

10.3.6 REFERENCE CITED IN RESPONSE TO COMMENTS

Taylor, Walter P., editor. 1965. Genus *Odocoileus*. Their history and management: The Wildlife Management Institute, Washington, D.C.

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